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FOR ENGINEERS AND CONTRACTORS CONTROLLING THE DESIGN, SPECIFICATION, INSTALLATION AND MAINTENANCE OF HEATING, VENTILATING AND AIR CONDITIONING.

HEATING & VENTILATING

AIR CONDITIONING

FOR JUNE, 1939

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Where Heat Must Not Fail– Install this SAFE Heating Pump!

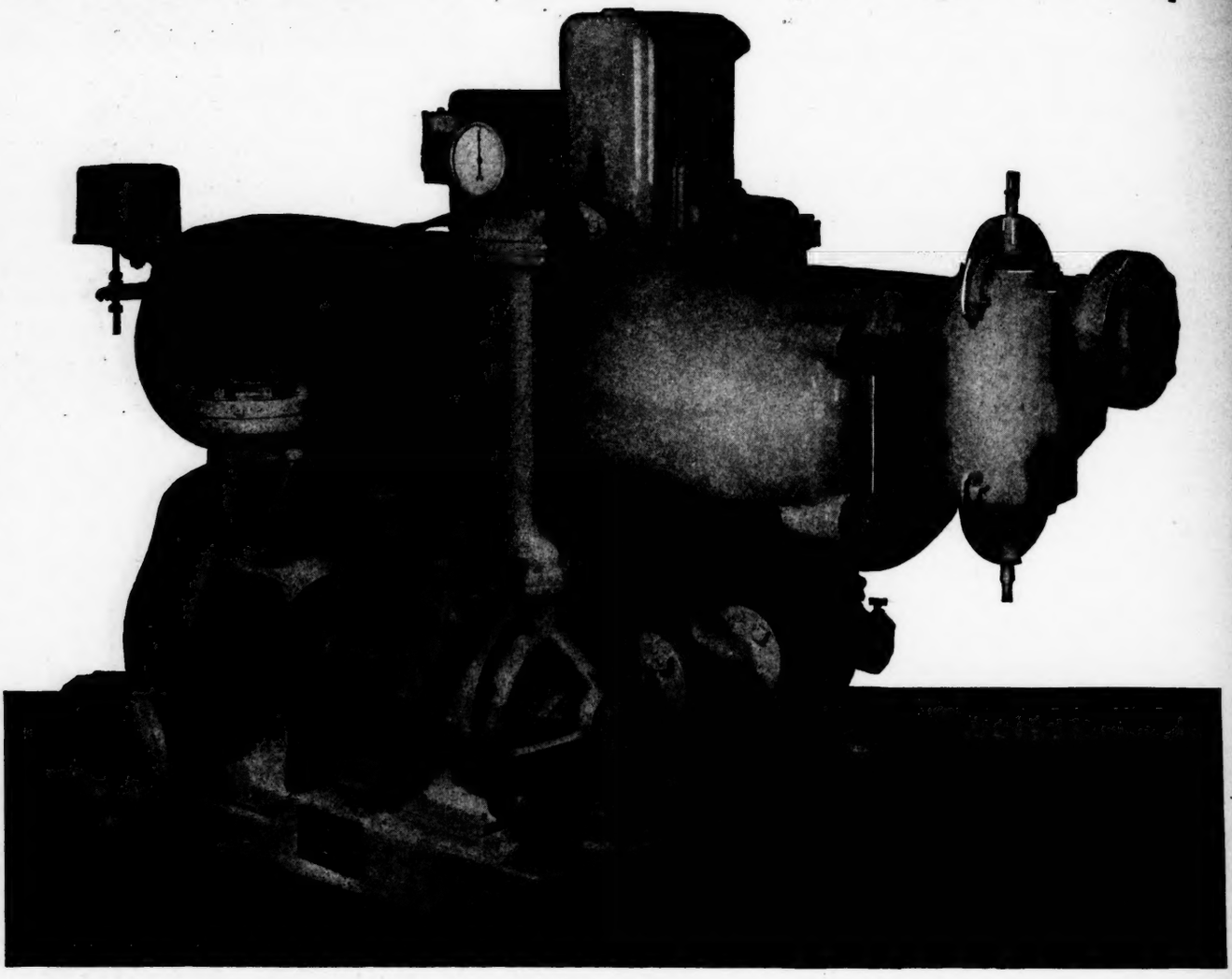

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Fig. 1. Architect's drawing of part of Parkchester. A construction view of this project is shown on the cover.

51 Buildings Served by Central Plant with Four Oil-Burning Boilers

By P. W. ANDERSON†

THE Metropolitan Life Insurance Company's Housing Project, Parkchester, located in the Bronx, in New York City, is believed to be the world's largest apartment community planned by private capital. It consists of 171 dwelling units, averaging over eight stories in height, which are grouped in 51 separate structures designed to accommodate more than 12,000 families. It also provides recreational and amusement facilities, garages and shopping centers with over 9000 lineal feet of shop street frontage.

Of the 129 acres included within the property lines 27% is covered by the apartment buildings, garages, etc., leaving ample room for parking spaces, play grounds and lawns.

The heating and hot water supply systems in the apartment buildings being installed by Baker, Smith and Company, Inc., furnish sufficient material for a separate article and are to be fully described in the July issue. Briefly, these systems are designed to use steam at approximately 5 lb. per sq. in. gage and will exhaust over an operating range between 2 lb. per sq. in. gage and 25 inches Hg. vacuum. Insulation of the buildings has served to reduce the space heating requirements to approximately one and one-half times the hot water heating requirements. This will result in low fuel costs per capita as well as a low capital expenditure for steam generating equipment.

After an exhaustive economic study the Board of Design decided to supply the steam from a central heating plant and supply the various buildings by means of a steam transmission system consisting of underground concrete ducts, insulated steam mains, and condensate returns.

There are 29 heater rooms which are the distributing points for heating and hot water requirements. In addition to pressure reducing stations, these heater rooms also contain the hot water heaters, the condensate return equipment and in many instances the basement sump pumps.

The most spectacular building project erected by private capital in years—the Parkchester housing development in New York, under construction by the Metropolitan Life Insurance Company—is described in this, the first of two articles on the project. Mr. Anderson describes the central heating plant and transmission lines in the accompanying article. Next month the heating systems within the 51 apartments will be discussed.

The boilers will be operated at 100 lb. per sq. in. gage pressure, and during the heating season steam will be supplied to the pressure reducing stations at 90 lb. per sq. in. gage at times of light loads when the friction losses in the transmission system are small and at pressures ranging down to 60 lb. per sq. in. gage at the ends of the lines during

†Of Burns & Roe, Inc., Consulting Engineers, New York.

peak load periods. During the summer months the entire transmission system may be operated at a reduced pressure if desired.

Pressure reduction in the heater rooms will be accomplished in one step with single disc valves to insure a tight shut-off. These valves are operated by an independent pilot regulating the water pressure on a spring opposed diaphragm on the main valve. Water drains to waste only on closing of the valve. Each main valve has a single spring closing seat and the inlet steam pressure acts to keep the valve closed. Valve seats will range from 3 to 5 inches in diameter and will be supplied with stellite-faced seat rings. Failure of water pressure or diaphragm closes the valve and failure of any spring, main poppet or diaphragm or internal pilot permits continued though imperfect operation.

Each pressure reducing station consists of two pressure reducing valves connected in series. The first valve will be adjusted to maintain a slightly higher pressure than the second valve and therefore will remain wide open as long as the second valve is working properly. Each pressure reducing valve is supplied with a hand operated by-pass valve to permit maintenance without interrupting the steam supply. By-pass and shut-off valves will be supplied with locking devices to insure against unauthorized manipulation.

To minimize undesired heat release in the heater rooms or where the transmission line passes through a basement area the thickness of the pipe covering will be materially increased at these points. In addition forced ventilation is being provided for all heater rooms.

The transmission system is designed for parallel flow of steam and steam line condensate except at points where it becomes necessary to increase the elevation of the pipe. All increases in elevations are accomplished by means of vertical risers and the velocity of the steam at peak load does not exceed 8000 feet per minute at these points. Immediately ahead of each riser a large condensate drip pocket is welded into the line and where possible the condensate is led to the nearest condensate pump to be returned to the plant. The maximum design velocity is well under the acoustic limit and the minimum slope of the steam line is three inches per hundred feet.

Steam line expansion is to be taken in packless type welded expansion joints, both single and double, which are being constructed to include special features for this project. The expansion joints are located at angle points in the transmission line or wherever else a branch line may be taken off for a building or group of buildings. At angle points the branches are taken off at the intersection of the center lines of the mains from the top of the bend in the double expansion joints. The bend is also provided with an anchor base and a drip pocket where the location is convenient for the removal of condensate and where necessary to clear the main.

In long runs the steam line is anchored half-way between expansion joints to reduce the traverse to a reasonable dimension. In short runs the line is anchored at one end and free to move at the other.

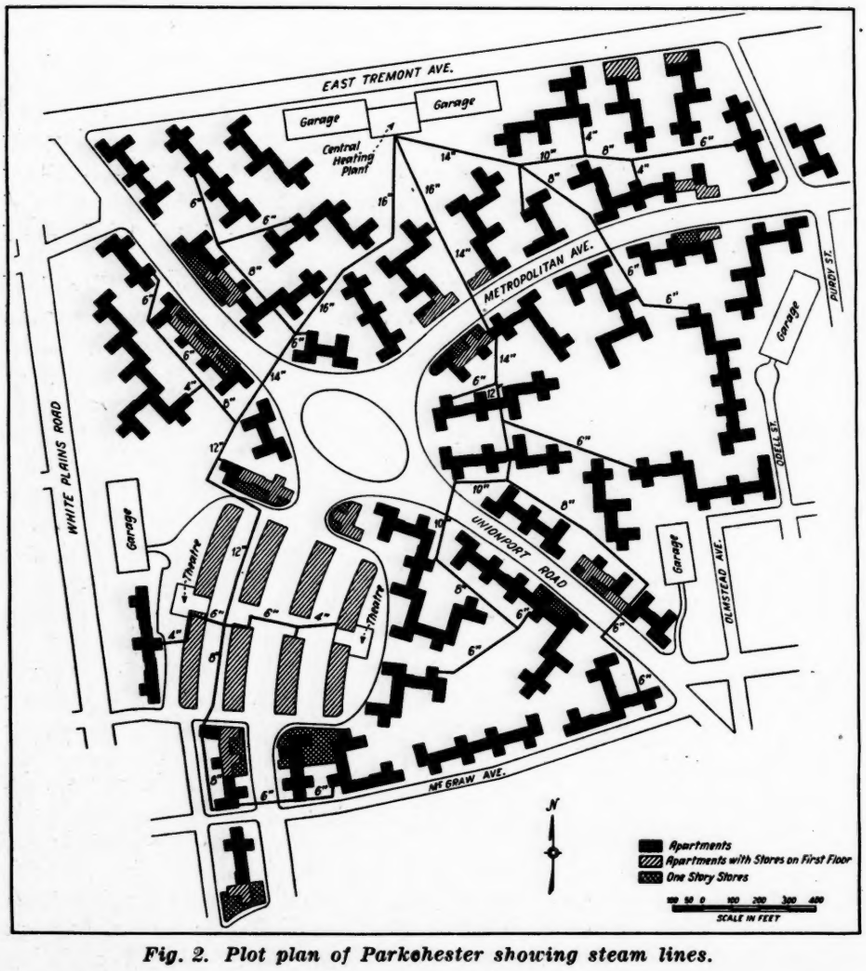


Fig. 2. Plot plan of Parkchester showing steam lines.

The piping is supported on roller pipe supports spaced according to the pipe diameter and guided with equally spaced guides. One guide is placed within three feet of the end of the expansion joint to protect it against lateral movement or weaving which would tend to "cramp" one side and distend the opposite side.

The entire steam line from the plant to the pressure reducing valves in the various heater rooms is to be welded. Due to the low pressures and temperatures involved gas welding will be permitted in the field and to this end several experienced welders have been qualified by stringent tests witnessed by representatives of the owners and the engineers.

Insulation of the steam piping will consist of double standard 85% magnesia waterproofing and a copper jacket.

Where the duct system is close to the surface under shrubbery, macadam walks or the like, additional heat insulation will be provided by filling the duct with mineral wool. To permit the flow of seepage the

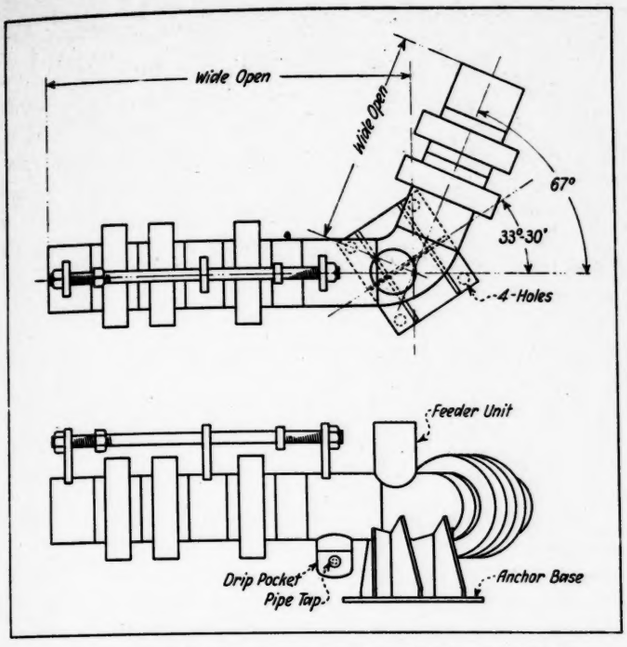


Fig. 3. Typical double expansion joint as used in Parkchester and described in text.

mineral wool will be supported by a blanket resting on half sections of drain tile.

In designing the duct system the fill load was computed by Babbit's trench formula,

$$W = CWB^2$$

Where truck loadings occurred the rear axle load of a 20-ton truck was assumed as a point load. Concrete is stressed at 650 lb. per sq. in. and steel at 18,000 lbs. per sq. in. A moment coefficient of 10 was used for the top and bottom slabs to provide some rigidity.

The minimum thickness of bottom slabs is 9 inches and 6 inches for top slabs. The side walls are 8 inches thick for all locations.

Since there is sufficient length of each size of piping to justify several sets of forms the duct dimensions vary with the size of the piping and are dimensioned to result in the lowest overall installation costs.

Manholes varying in depth from four to 20 feet are all designed for a six-foot radius circular form. Shallow manholes and those containing the vertical risers previously described are designed for a flat slab top while those of sufficient depth will be provided with a conical top.

The transmission system consists of three mains, two 16-in. diameter and one 14-in. diameter, feeding in three directions from the central heating plant as indicated on the property plan.

Steam line condensate is removed by means of drip pockets and traps at several positions in each main and where possible the slope is continuous to the end of the line. For instance the line extending through the central section of the property drains continuously from the plant to building S4. The line extending into the western section steps up in the second and third manholes but from the third manhole it slopes continuously to its end at building S7. All branches in this line are stepped up to meet the elevations of the various buildings.

Each major branch line is provided with a gate valve primarily to permit operation of buildings further along the main before such a branch is installed. Each main line is supplied with a motor operated gate valve at the header in the plant. The general routing of these lines has been determined partly from consideration of finished grades, building elevations and locations as well as elevations and locations of sewers, the result in many instances being a compromise.

Although there are no radiator valves in the heating system there will be other points such as condensate tank vents, heating coil vacuum breakers, and vacuum pump connections which will admit air to the condensate system.

After lengthy investigation of the possibilities of keeping all air out of the system; of local de-aeration in the heater rooms; of maintaining the entire system electro-negative; of making chemical corrections, and so on, it was decided that air saturated condensate was a condition to be met instead of eliminated. Further investigation of the economics and the properties of the various possible condensate pipe materials resulted in the selection of standard weight 85% copper (red brass) piping for this service.

Condensate line fittings will be of Composition "M" containing approximately 88% copper and all joints will be brazed.

Single internally guided expansion joints are to be used to permit free expansion of the condensate piping. Anchorage will be accomplished between expansion joints and the scheme of providing straight runs between anchors and expansion joints will be used, thus making the general design of the condensate return system similar to that of the steam line.

The transmission system contains over 14,000 lineal feet of steam piping ranging from 20-in. diameter for the vertical risers to 4-in. diameter for a few of the heater room feeders. A similar length of condensate piping ranging in size from 6 inches to 1½ inches is also required.

The steam volume of the entire system plus the water volume variations in both vacuum system receivers and condensate receivers necessitate considerable water storage. For this purpose a concrete surge tank, lined with high temperature bitumastic, 40 ft. long, 11 ft. wide, and averaging 7 ft. in depth, is located below the basement floor of the central heating plant. Condensate is pumped from the heater rooms directly to this tank.

As previously stated the condensate has been exposed to air and at certain times during each day's heating cycle has absorbed oxygen and CO_2 to or near the saturation point. The action of these two gases in the presence of moisture on any ferrous material is only too well known and has resulted in costly early replacements of equipment and piping in many instances.

A de-aerating heater designed to reduce the oxygen content to zero for all flows up to 350,000 lb. of condensate per hour and to 0.03 p.p.m. at a maximum flow of 500,000 lb. per hour has been installed for protection of the boilers and the heating system.

Steam driven auxiliaries which exhaust to the de-aerating heater are designed to deliver full rated horsepower when operating against a back pressure of 15 lb.

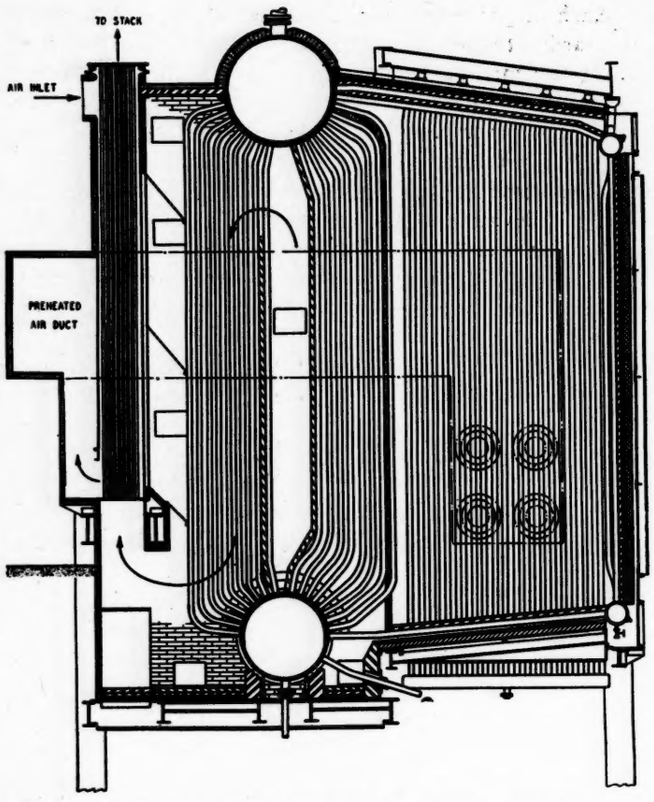


Fig. 4. Vertical section through one of the new steaming units for Metropolitan Life Insurance Company's new Parkchester project. Oil is burned by four burners in each boiler in a completely water-cooled furnace. The gases pass horizontally through the first bank of boiler tubes and vertically downward through the second bank. The last pass is upward through the tubes of an air preheater.

per sq. in. gage. The back pressure is expected to average 7 lb. per sq. in. gage. Although the de-aerator and exhaust system is naturally self regulating within reasonable limits it will be held strictly within the operating range between 3 lb. per sq. in. gage minimum and 15 lb. per sq. in. gage maximum. When the pressure tends to drop below 3 lb. per sq. in. gage a pressure reducing valve will supply the deficiency in exhaust steam directly from the main steam header. An alarm is sounded when this valve operates so that the man on watch may make the necessary changes in the auxiliary equipment to restore the pressure. When the pressure in the de-aerator rises to 14 lb. per sq. in. gage the same alarm warns the operator of the necessity of reducing the volume of the auxiliary exhaust. At 15 lb. per sq. in. gage a relief valve in the auxiliary exhaust steam piping starts to discharge steam thru the relief piping which extends through the roof.

Condensate is pumped from the surge tank, through the vent condenser, an integral part of the de-aerator, to the top of the tray bank in the de-aerator. After deaeration the water is suitable for boiler feed and flows by gravity to the boiler feed storage tank (the deaerator is mounted on this tank) which has sufficient capacity to feed the boilers at full load for a period of ten minutes if the supply is interrupted for any reason whatsoever.

Feed water is pumped to the boiler drums by constant speed turbine or motor driven pumps, whichever is required to obtain a heat balance as explained later. Feed water regulators, one per boiler, are being installed for automatic feed control. The regular, as well as a hand feed valve for emergency use, will both be located hand high from the operating floor and near the firing aisle.

Four two-drum, D-type, bent-tube boilers each designed to generate 135,000 lb. of dry saturated steam per hour continuously at 100 lb. per sq. in. gage, when supplied with feed water at 225F are on order. The engineering specifications for these boilers were designed to safeguard the units against burned tubes and attending high maintenance costs by limiting the steam water ratio in all tubes. A further precautionary measure written into the specification to insure continued satisfactory operation of the heating system limited the solids permissible in the steam leaving the boiler at maximum boiler capacity.

At medium or high steam pressures these two requirements could be met by all manufacturers of standard design boilers. However, since these boilers were to operate initially at a relatively low pressure, 100 lb. per sq. in. where the specific volume of the steam is large, all manufacturers were compelled to modify their designs somewhat.

In the boilers selected these conditions were met by increasing the diameter of the top drum to 72 in. and materially increasing the number of circulators as well as increasing their diameters.

The average heating curve has a very high peak of relatively short duration. As previously stated the ratio of space heating to hot water heating is about 3 to 2 for this project as compared to ratios as high as 5 to 2 for the average heating requirement. This low ratio results in a relatively high boiler capacity and a substantial improvement in the shape of the load duration curve. These factors combined with other economic considerations justified the purchase of sufficient heat absorbing surface in the boilers and air preheaters to result in a flat characteristic boiler efficiency curve so that a yearly average of over 85% efficiency is possible after making ample allowance for operating contin-

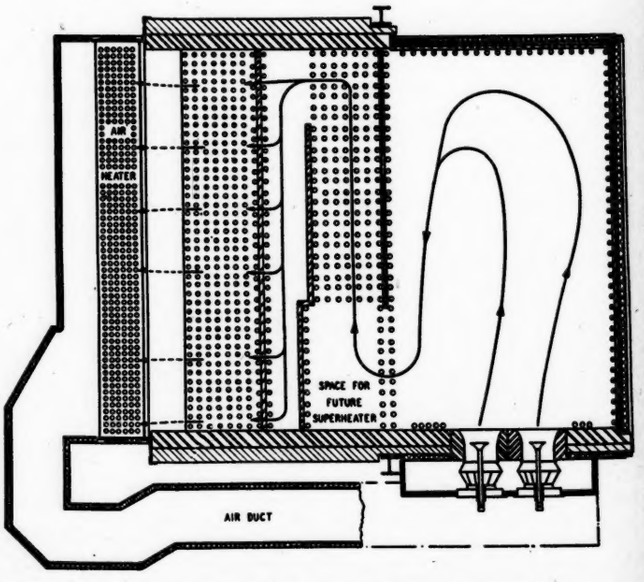


Fig. 5. Horizontal section through boiler showing reverse flow of gases in furnace.

gencies. (85% efficiency with oil firing is equivalent to about 86.2% from coal.)

To allow for possible future installation of turbo-generators utilizing steam at a pressure higher than the initial boiler operating pressure, provision has been made in the boiler design for a future operating pressure of 450 lb. per sq. in. at the superheater outlet. Space is left in each unit for the future installation of convection superheaters that will deliver steam at a temperature of 600F. Future design includes the installation of pulverized fuel firing equipment and economizers to maintain the high efficiency which would otherwise be lost when the steam pressure is increased for turbo-generator operation.

The layout of these steam generators represents an effort to obtain a high degree of furnace cooling in a design having low head room. The compactness of the units is illustrated by the overall dimensions of approximately 25 ft. width, 21 ft. depth, and 29½ ft. height. Gases from the four oil burners pass toward the rear of the furnace, reverse their flow through 180 degrees, and return toward the front of the furnace to the entrance into the main boiler tube bank. Turning again through 180 degrees, the gases leave the furnace, passing around the first baffle, through a slag screen consisting of two rows of 3¼-in. diameter tubes, and continue horizontally toward the rear of the unit across the tubes in the first boiler bank. Continuing their flow in horizontal planes they turn again at the rear of the first boiler bank through 180 degrees around a second baffle into an open space between boiler tube banks where the direction of flow is changed from horizontal to vertical. After turning up vertically the gases pass over the top of a third baffle and through the second bank of boiler tubes. The gases flow downward through this bank, parallel to the tubes, and turn at the bottom through 180 degrees into the vertical tubes of an air heater through which they pass on their way to the stack.

Air for combustion enters the top of the air heater and flows downward over the tubes in a direction counter-current to that of the gas, leaving at the bottom after making a single pass through the heater. The air is then led through a duct across the front of the boiler to the four burners.

Each furnace is completely water-cooled with closely spaced, bare tubes in the rear wall, side wall, and roof. Fewer water tubes are used in the front wall to accommodate the oil burners. Water tubes are also located beneath the refractory floor of the furnace. The first row of boiler tubes forms the inner side of the furnace and continues into the first row of slag-screen tubes.

As indicated in the various sectional views of the plant the bottom drum is below the level of the operating floor. All burners are accessible from the operating floor without the use of platforms. All furnace observation doors, three in the side wall and three in the target wall, are located eye high (5 ft. 3 in.) above the operating floor.

Top drum access platforms, both front and rear, are located immediately under the top drum to facilitate inspections and provide access to water column valves and piping.

Above this platform and extending across the boiler along the top of the drum a narrow cat walk is hung from the fan floor to provide access to the safety valves and the 12-in. non-return valve.

Air for combustion is supplied by a forced draft fan which is mounted on the same shaft with the induced draft fan. These fans, one per boiler, are driven through reduction gears by variable speed 300-horsepower turbines. The fans and drivers are large enough to permit changing to pulverized fuel firing without alteration of this equipment. Maximum fan speed for pulverized coal operation will be 1050 r.p.m.

Each turbine is equipped with two automatic steam inlet valves to obtain efficient operation at low speeds.

The exhaust from these turbines is used in the deaerating heater and at low condensate flows the amount of exhaust which can be utilized for this purpose is less per pound of condensate than at higher flows due to a higher return temperature. (A larger proportion of hot water heating condensate raises the return temperature.) For this reason a heat balance can be obtained at light loads only by high efficiency from the fan drivers and the utilization of motor driven boiler feed pumps. At maxi-

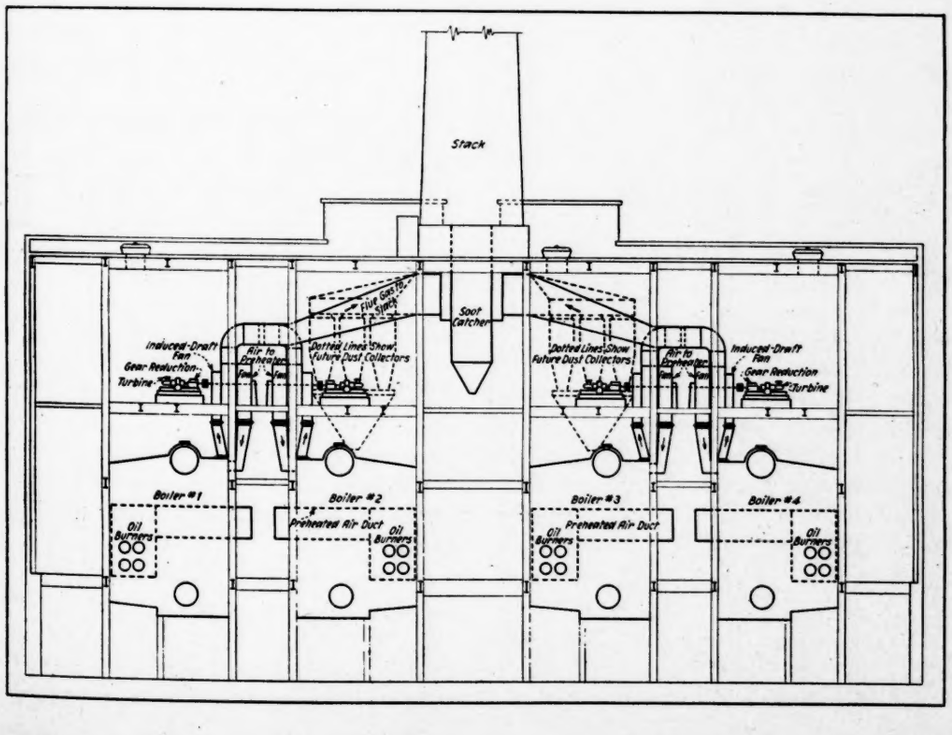


Fig. 6. Longitudinal elevational section through central heating plant.

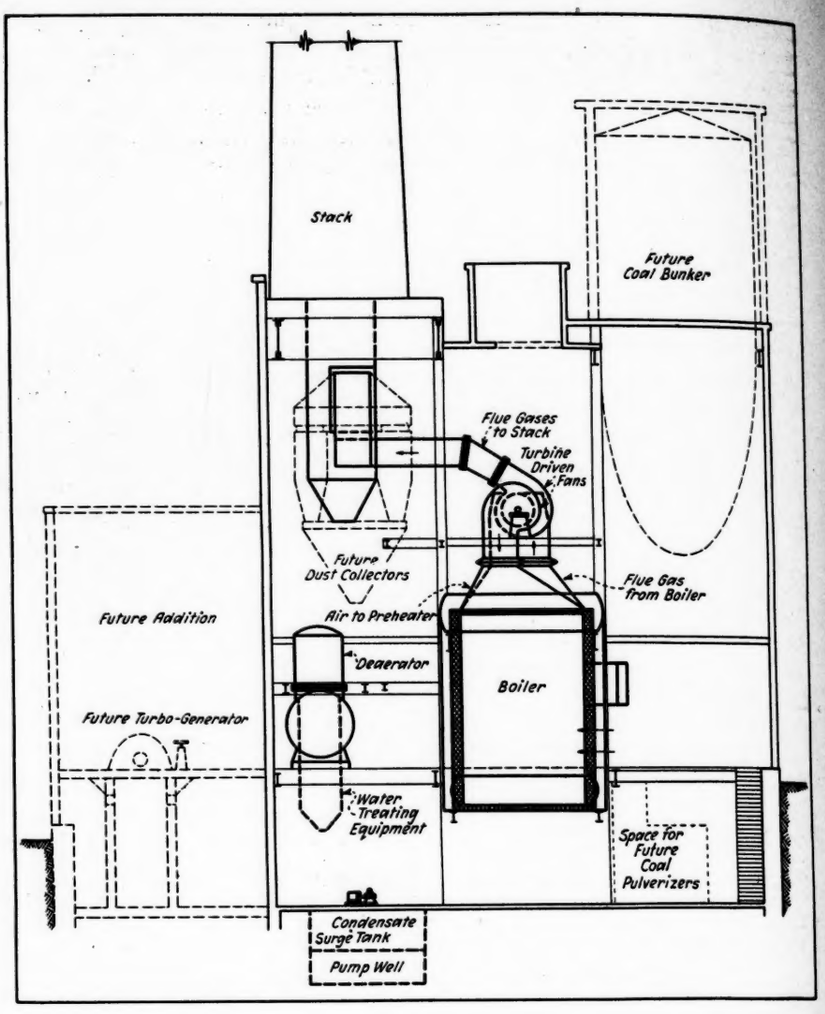


Fig. 7. Cross-section of heating plant, showing boiler and breeching arrangement and location of auxiliaries.

mum boiler loads and at extremely light loads when the fans are unnecessary the steam driven boiler feed pumps are required for the heat balance.

The products of combustion are finally discharged at a sufficient height and velocity to avoid any possible discomfort to inhabitants of the surrounding territory. The stack is constructed of radial brick to blend with the general architectural color scheme. It is supported by the building steel and the gases enter the stack vertically through the supporting slab. The stack is designed to withstand wind velocities up to 125 m.p.h. with ample factors of safety.

Space has been provided in the present structure to permit future installation of pulverized fuel firing equipment as well as coal storage in a bunker above the firing aisle.

For the present the boilers will be oil fired and are each equipped with four wide range oil burners each guaranteed to operate satisfactorily over an 8 to 1 ratio.

Fuel oil may be received by truck from tidewater or by tank cars which can be spotted on a siding opposite the plant directly across East Tremont Avenue. Storage facilities for a ten-day supply during the coldest weather is provided by four tanks located between the plant and East Tremont Avenue. Each of these tanks, which are 75 ft. long, will store approximately 64,000 gallons.

Space directly above the fuel oil tanks is to be used for a gasoline service station with facilities for dispensing over one million gallons per year. The tops of the oil storage tanks are approximately 13 ft. below grade necessitating special construction and bracing.

Each tank is provided with a heater capable of raising the temperature of 60 g.p.m. of oil through 25F. These heaters use auxiliary exhaust steam and discharge the condensate (by means of a vacuum pump) to the surge tank.

The electrical design for the central heating plant is based on the use of Consolidated Edison service. Duplicate incoming feeders come underground to the plant and each of these normally supply power to half of each set of electric auxiliaries and the lighting for half the plant.

Use of Edison service determines the voltage for the electric auxiliaries at 208 volts, 3 phase and simple across-the-line magnetic type motor starters with thermal overload protection have been used so far as the utility's regulations permit. The electric auxiliaries including four condensate pumps, two boiler feed pumps, and four burner oil pumps have push button control on the combustion control board as well as near the motor. (All fans and two boiler feed pumps are steam turbine driven.)

In order to cut labor and material costs, a special rubber and tape power cable is used which is impervious to water, in place of the usual rubber cable with a lead sheath.

A complete automatic combustion control system will be installed to take full advantage of the inherent high boiler efficiency and guard against smoke. The system will be so arranged that it can be switched from complete automatic to manual control for starting a boiler unit with each control adjustable either locally or from the control panel.

Boiler room instruments are mounted on the same panel with the combustion control providing indicating instruments as well as recordings, complete for the station performance.

With the control panel centrally located in front of the boilers, including all motor operated valve closing stations and remote control of all motor driven auxiliaries, the plant may be operated with the minimum attendance required by law.

District Steam Plant in Concord, N. H., Serves Downtown Business Section

By MORRILL DAKIN†

An all year steam service is not common in this country but in Concord the service is maintained throughout the whole year. To accomplish this a new district installation was made late in 1938 with a boiler plant of over 600 boiler horsepower, with over 4000 feet of underground steam distribution lines, and with a present output of over 22,000,000 pounds of steam per year in a city of 26,000 population.

Fig. 1. Concord, as seen from the top of the Steam Corporation plant.

CONCORD, capital of New Hampshire, has a population of 26,000 persons. It is essentially a residential city with a compact business area having a high percentage of office buildings due to State government work. The average heating season is equivalent to 6800 degree days. With compact area and more than average heating season, Concord was felt to be a suitable location for the development of district steam for heating purposes. Fig. 1 is a view of the business section of the city as seen from the top of the stack of the new heating plant of the Concord Steam Corporation.

Construction of the boiler plant and the distribution system was started the first of August, 1938, and steam was available to customers on December 19, 1938. Three horizontal return tubular boilers were installed, each of 203 hp. rating, with adequate space in the present building to take care of one additional unit. The boilers are set 8 ft. above the floor level and are equipped with oil burners for burning Bunker C fuel oil. The auxiliary equipment consists of two steam driven feed water pumps, feed water heater, duplicate steam driven oil pumps and heaters, and a steam driven pump for unloading oil. Two 17,000 gallon tanks provide the necessary oil storage capacity.

Oil shipments can be received by either truck or rail. Water is supplied from the municipal system under both high and low pressure. High pressure water comes from a high pressure reservoir, while low pressure water runs directly from the supply pond into the distribution system. Every effort has been made to guard against shutdowns by duplicating essential equipment and providing dual water supply and oil transportation facilities.

Oil is heated in the supply tanks at the draw-off pipe by small basket type heaters, and is drawn into the plant at 80F. The pump circulates the oil through the heaters, increasing the temperature to 150F and delivers it to the oil burners where it is atomized with steam. Automatic control equipment adjusts steam and oil pressures and draft to maintain a boiler pressure of 75 lb. gage. Recording steam flow meters measure the output of each boiler, and other recording instruments give the required information on plant operation.

†Manager, Concord Steam Corporation, Concord, N. H.

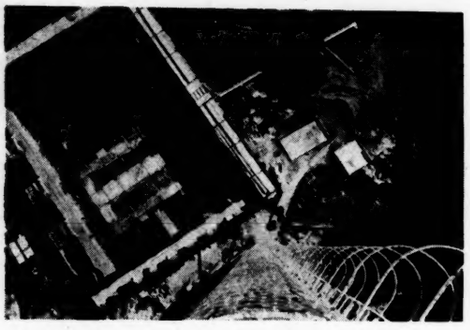
Wood Burning Tried

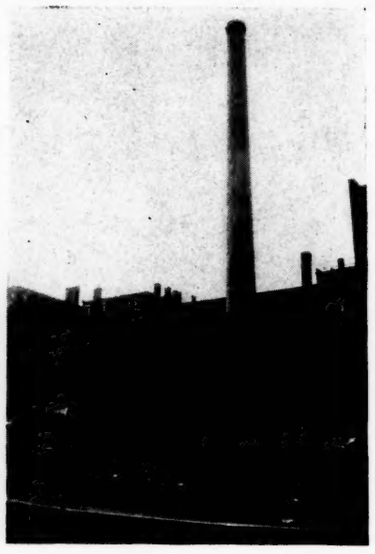
The boiler plant was under construction at the time of the New England hurricane on September 21, 1938. The boilers were in place but the settings had not been started. In view of the amount of timber blown down, and the quantity of cord wood which would be available, it was felt that it was a worthwhile experiment to build grates and fronts into one of the oil burning furnaces so that wood might be used as a fuel. Lack of sufficient room in the boiler plant prevented the construction of a Dutch oven, so flat grates level with the bottom of the firebox door were run back for a distance of 5½ ft. instead. Green white pine slab wood has been tried as a fuel and results would indicate that the furnace is not suited to burning this kind of material. Draft induced across the top of the fire when the firebox door is opened for stoking blows the flame from the surface of the slabs and they fail to re-ignite when the door is closed. Grates placed lower than the bottom of the firebox door would probably be more satisfactory.

Dry white pine slab wood has also been used as a fuel with much greater success. During one test 4¼ cords of these slabs were burned in the furnace in 6 hours. The boiler pressure was maintained at 75 lb. and the steam output to the mains was 32,500 lb. Feed water temperature was 228F. This would indicate a total of 31,730,000 B.t.u. or 7,513,000 B.t.u. per cord. Assuming boiler efficiency at 60% there were available 12,522,000 B.t.u. per cord. Marks "Mechanical Engineers Handbook," for air dried white pine, gives 14,522,000 B.t.u. per cord. When it is considered that slab wood contains a high percentage of bark in which there is little heat value, the figures represent reasonable agreement. As a comparison, straight oil opera-

Fig. 2. (Below) Looking down from the top of stack on the heating plant under construction.

Fig. 3. (Right) The heating plant of the Concord district heating company.





tion for the first three months of 1939 has given efficiencies varying from 73.3% to 76.4% with evaporation of 13.9 to 14.3 lb. of water per lb. of oil. Steam for the auxiliaries has been included with steam output to the mains.

In order to utilize the wood burning boiler when wood was not available, an oil burner was installed. The first attempt was to place the burner tip about 4 ft. above the grates and point it down at a slight angle. Some trouble was encountered in keeping this burner operating, as it had a tendency to blow itself out. This was undoubtedly due to the fact that the drooling block on which the burner would normally rest was omitted because there was no suitable way of supporting it.

The second attempt was more successful. The burner tip was installed one foot above the grates and directed horizontally with them. A drooling block was built up from the grates to meet the burner, and straight oil operation with this construction has been very satisfactory.

Distribution System

The distribution system consists of 1093 ft. of 12-in. pipe, 205 ft. of 10-in. pipe, 1213 ft. of 8-in. pipe, 1591 ft. of 6-in. pipe, and 250 ft. of 4-in. pipe. This makes a total of 4352 ft. which is all under ground. Welded steel construction was used throughout, supported with rollers and saddle plates upon a concrete foundation. Multiple diaphragm variators take care of expansion. Insulation consists of asbestos pipe covering, 2 in. thick, covered with a waterproof jacket. The sides of the conduit are of multicell tile, and the top is a concrete slab.

As can be seen from the plan sketch shown in Fig. 7 the distribution piping is arranged to loop some of the central blocks of the city.

During the construction of the distribution system it was found necessary to pass beneath a building and make an abrupt 24-foot rise at the same location. The accompanying sketch (Fig. 6) shows the existing condition and the manner in which the pipe was laid. The building was originally a stable in connection with a hotel. The existence of an old vault below ground on one side of the stable prevented a single rise, making it necessary to construct two *chimneys*.

At each riser a concrete foundation was poured to which was attached a flat steel plate. One flange was removed from a short section of I-beam, and the web was cut to conform to the exterior of the bend and welded in place. The remaining flange rests against the steel plate and slides with expansion and contraction. The surface of the plate was coated with graphite grease to prevent binding. This arrangement gives adequate support to the risers and at the same time permits the necessary travel.

At another point in laying the steam mains an old abandoned water distribution system was encountered. It was composed of 12-foot lengths of pine logs about 12 in. in diameter bored with approximately a 4-in. hole. Joints were made by reducing the outside diameter at the end of one log and driving it into the enlarged hole of the next. To prevent splitting, hand wrought iron ferrules were used. Several lead service pipes leading from the wooden main were also found. Inasmuch as the system contained no water, the sections of the main and services which were in the way were merely cut out.

Fig. 4. Boilers in place ready for settings.

Fig. 5. Oil storage tanks being put in place.

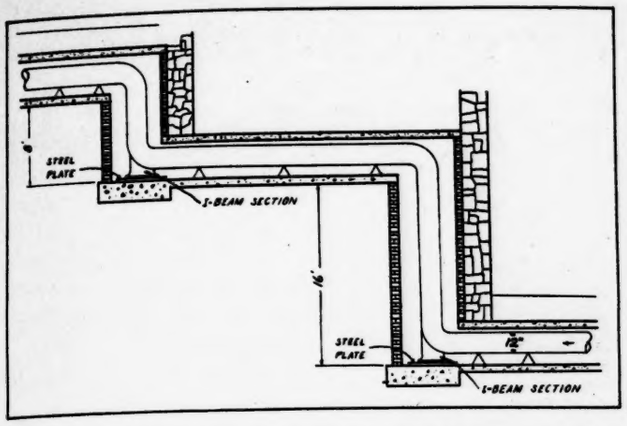


Fig. 6. Sketch showing how 12-in. distribution pipe was passed under a building and then raised 24 ft. while avoiding an old underground vault.

Pressure Maintained All Year

Steam service is applied under 75 lb. pressure continuously through the year. It is the practice of the company to install the service line from the steam main through the customer's wall complete with shut-off valve. In addition the company supplies a pressure reducing valve and meter with strainers for each which are placed by the customer. Under most conditions the company's pressure reducing valve is adjusted to deliver steam under 15-lb. pressure. Under some circumstances, as in the operation of laundry equipment, for example, where 15 lb. is inadequate, steam is delivered under the pressure requested by the customer.

Condensation meters are most commonly used for the measuring of steam consumption. In a few cases where it is difficult or impossible to collect returns for this type of metering, steam flow meters have been installed. None of the condensation from customers' use of steam is returned to the plant. Without exception it is discharged to the city sewer system. Where economizers of one kind or another are not installed to utilize the heat in the condensate, some form of cooling is devised before the water is discharged into the sewer.

Condensate from the distribution system is handled in two ways. One part is discharged directly to the city sewers from trap manholes. The remainder is that which condenses in the first 553 ft. of 12-in. main leading from the plant. This section of the main all pitches up hill from the plant so that a trap at the plant discharging into the feed pump receiver is an effective means of collecting this condensation.

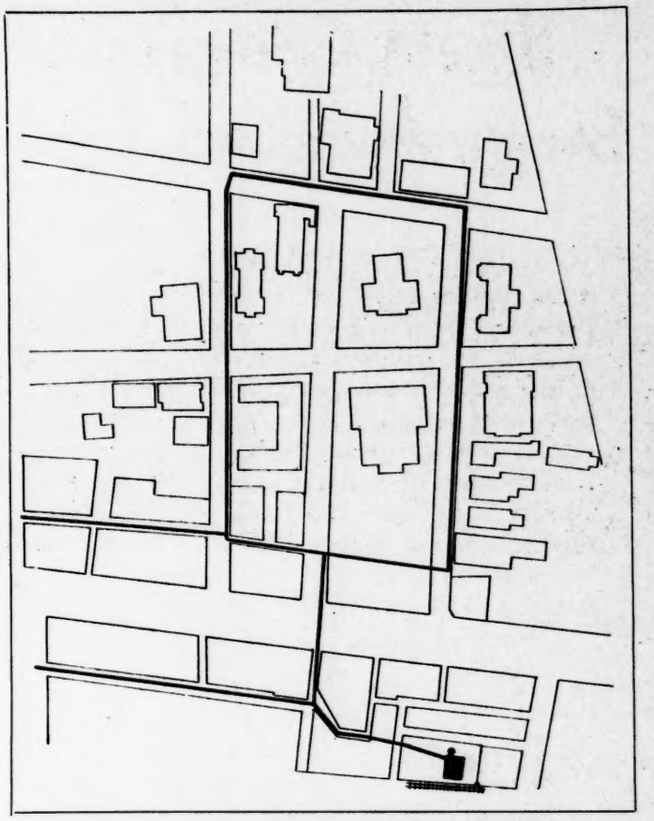


Fig. 7. Diagram showing location of distribution piping and of heating plant.

Customer problems have presented nothing new to the art of district steam heating but the problems are nonetheless real. Much time has been spent with building operators to acquaint them with handling the new method of heating, and suggestions for using steam economically have been made.

During the first winter of operation the connected load has been built up to about 22,000,000 lb. of steam per year. There is reasonable possibility of expanding the load to 50,000,000 lb. of steam per year in the future without the necessity of extending the distribution system. With expansion there is an ultimate load of 80,000,000 to 90,000,000 lb. annually.

Hot Springs to Heat Iceland's Buildings

FOR some time now consideration has been given to a central heating plant for heating the buildings of Iceland's capital city, Reykjavik, with the water from hot volcanic springs. Realization of the plan seems near now due to plans recently submitted by a Danish engineering firm to erect the central heating plant for about $1.5 million.

At the present time more than 200 gallons per minute flow from the hot springs in the neighborhood of Reykjavik and it is believed that considerably more can be obtained by tapping the springs. The new heating system is expected to be particularly valuable for gardening purposes. Vegetables are rare in Iceland because the climate is too severe for their normal growth. Around the hot springs, however, big garden plantations have sprung up during the last few years which are reported to be able to grow even semi-tropical products.

Steam Compressors Make Low-Pressure Steam Available for High-Pressure Equipment

By L. V. GRANTIER†

Where low-pressure steam is used for building heating, there is frequently a demand for limited amounts of high-pressure steam for laundry, pressing, and like equipment. One way to get high-pressure steam is by putting in a high-pressure boiler, but another way is to compress the low-pressure steam. In Detroit this compression has been successfully applied in a number of cases over a considerable period of years. This article was made available through the cooperation of the Educational Committee of the National District Heating Association.

THE Detroit Edison Company has demonstrated that steam at a pressure of 25 to 30 lb. per sq. in. can be compressed to pressures up to 100 lb. per sq. in. economically and safely. It is feasible to compress steam from pressures lower than 30 lb. to 100 lb. per sq. in., but the investment and operating costs of the larger compressors per pound of steam compressed will be materially increased and the steam delivered will be superheated to a higher temperature. For a given capacity by weight, the displacement of a compressor operating with a lower intake pressure must be increased to correspond with the increased specific volume of the intake steam, and increased an additional amount to compensate for the absorption of heat from the hotter cylinder and piston which expands the incoming steam and reduces the capacity.

Compressing steam in order to raise its pressure or temperature above that of the available supply is not a new idea but is one that is now being used to an increasing extent. Higher temperatures are the ultimate object of most compressor installations—the pressure, as pressure, being of secondary importance. Compression results in an increase in temperature as well as an increase in pressure.

The desired temperatures can be secured by superheating the low-pressure steam, but for processes involving the use of heat transfer apparatus, saturated steam is much more desirable inasmuch as the temperature always remains constant for any given pressure, the heat transfer coefficient is higher, and the efficiency greater.

Constant temperature is desirable or necessary for most process work and is easily maintained by controlling the pressure of saturated steam. Dry saturated steam becomes superheated when compressed. When using compression ratios of 3 to 1, the superheat is rarely more than is sufficient to offset the radiation losses in transmission to the utilizing apparatus.

About ten years ago, a laundry in Detroit operating on district steam at a pressure of 35 lb. found that its steam equipment was performing at only half of its rated capacity. Investigation revealed that the presses, ironers, and dryers were designed to operate at 100 lb. pressure. A motor-driven compressor was installed, raising the pressure of the street steam to 80 lb. With this high-pressure steam, the capacity of the machines was greatly increased.

This installation consists of a double acting, feather valve air compressor having a 9½-in. bore and a 12-in. stroke belted to a 60-hp., d.c. motor arranged for variable speed, a receiver with safety valves in the discharge line of the compressor, and a throttle valve in the suction of the compressor controlled by the receiver pressure. A manual adjustment of the speed to the

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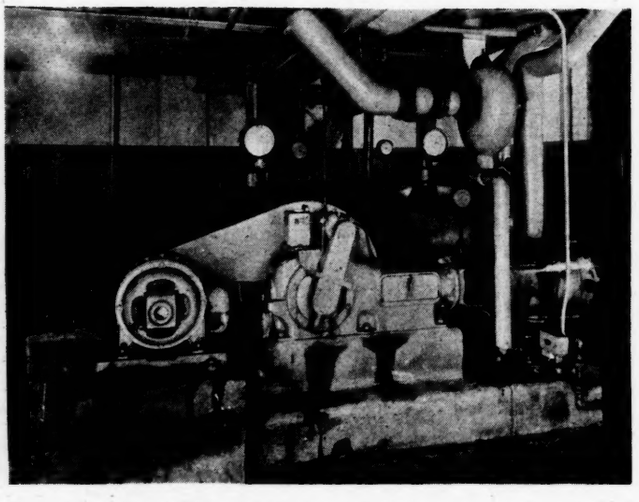
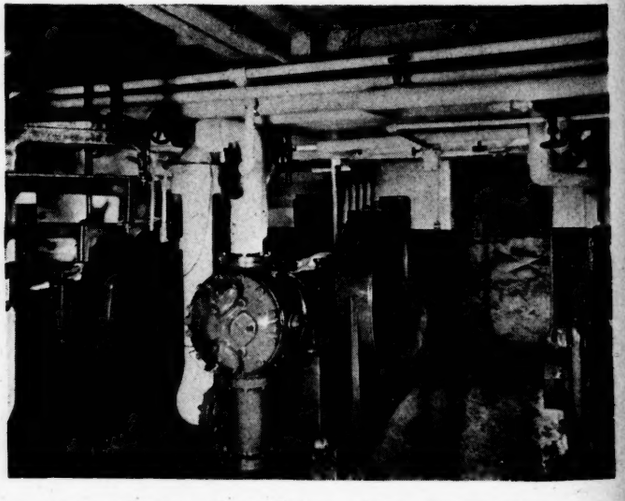




(Left) Motor-driven steam compressor at a large clothing store. (Right) Motor-driven steam compressors at the Hotel Statler, Detroit.

average load allows the throttle valve to take care of the ordinary fluctuations, and no steam is wasted at the safety valves. At 255 r.p.m. the capacity of the compressor is 1000 lb. of steam per hour at a pressure of 80 lb.; the power consumed is 40 kw-hr. per 1000 lb. of steam compressed.

Although the installation was more or less experimental, practically no changes have been made and no failures have taken place.

Another installation was made in a large clothing store to furnish steam for a battery of Hoffman presses. A single-stage, double-acting, straight line air compressor having a 6-in. bore and a 7-in. stroke was modified for this service. The modifications consisted in using stainless steel for the piston rod, valve discs, and valve springs; chrome iron for valve seats and valve guards; metallic piston rod packing, cylinder relief valves, and a distance piece between cylinder and main frame housing. The cylinder was lagged instead of jacketed, and a special tank with float and a mercury switch was provided to open the motor circuit should the suction line become filled with water. The compressor, driven by a 15-hp. induction motor with V-belt drive, is installed in the basement but may be started and stopped by means of a pushbutton in the press room.

A centrifugal unloader is provided whose function is to hold the inlet valves open until the compressor is up to speed, thus removing all but the friction load in starting. There is a weighted check valve between the suction and discharge and a safety valve on the receiver to guard against excessive pressures.

Since live steam is used to dampen the garments being pressed, it is essential that no lubricating oil from the cylinder reach the presses. Suitable separators remove all traces of oil in the compressed steam.

Steam is taken from the main at 30 lb. The discharge pressure is maintained between the limits of 80 and 55 lb. by intermittent operation of the compressor, which is stopped and started by an automatic switch controlled by the receiver pressure. A test of this unit showed a consumption of 29.3 kw-hr. per 1000 lb. of steam compressed. If gas-fired boilers were used, an analysis of fixed charges and operating expense would show an 18% increase in the cost of steam.

Due largely to the satisfactory performance of this installation, a large department store discarded the gas-fired boilers furnishing steam to the pressing department and installed a motor-driven compressor. This latter installation is similar to the one in the clothing store except that a compressor with a pressure unloader and a much smaller receiver is used. A duplicate unit was installed to serve the laundry department, displacing electrically-heated equipment.

These compressors have been operating for more than a year and have been perfectly satisfactory.

A little more than a year ago, a compressor having a capacity of 750 lb. of steam per hour, compressed from 30 to 85 lb. gage, was installed in a hotel to replace oil-fired boilers used to furnish high-pressure steam for laundry use. Although the power consumption is somewhat high due to the bypass method of pressure control, the operating cost of the laundry has been decreased. Space occupied by the boilers has been converted into valuable live storage. A considerable saving in capital investment was made by installing the compressor instead of renewing the boilers. Practically dry saturated steam is delivered to the mangles and presses in the laundry.

To replace the gas-fired boilers in the valet shop of this hotel, an unused carbon dioxide compressor was converted into a steam booster by the engineer in charge and has been giving excellent service.

Mention should be made of a steam-driven air compressor which was converted into a steam compressor to serve a valet shop in an office building. The use of purchased steam at 125 lb. was discontinued in this building and electric heaters substituted where feasible. Steam at a pressure higher than that supplied for building heating was necessary for use in a valet shop. To supply this steam, a steam-driven air compressor, made obsolete by the discontinuance of the 125-lb. service, was converted into a suitable steam compressor by bushing the air cylinder and making minor changes in the control. The operation has been satisfactory, and as all the exhaust is used for water heating the operating cost is small.

The latest installation in Detroit consists of three compressors rated at 1800, 1000, and 150 lb. per hr. in a large hotel. This hotel discarded its own boilers and changed to district steam service, and the compressors were installed to increase the district steam pressure from 30 to 100 lb. gage for laundry and valet shop use.

Compressors may be either motor-driven or steam-driven. If a large compressor is required and the exhaust steam can be utilized, a steam-driven unit will probably be more economical; the initial cost is more than that of a motor-driven unit, but the cost for driving power is small. For small units and where the exhaust steam cannot be used, motor drive is preferable.

For most purposes the pressure can best be controlled by a well-designed valve unloader which allows continuous running of the motor. If the service is intermittent with comparatively long periods of non-use when the pressure must be maintained, a pressure-operated control which stops and starts the motor within certain fixed pressure limits is more economical. A bypass control with check valve in the discharge may be used if the load on the compressor is fairly constant and does not drop much below the capacity of the compressor.

If the initial pressure is nearly constant, a properly designed steam-driven unit needs no special control, merely a conventional speed governor.

The earlier steam compressors were little more than standard air compressors having lagged cylinders instead of water-cooled cylinders, and their volumetric efficiency and rated capacity were based on air compressor practice.

These experimental installations reveal that where a supply of low-pressure steam is available, the compressor is a more convenient and desirable means of producing high-pressure steam than an auxiliary boiler, provided it is designed as a steam compressor. A compressor designed for air will not have the same capacity nor the same operating efficiency when used for compressing steam. On a cost basis, the compressor is superior unless the steam requirements are very low.

Steam Piping Connections

STEAM piping for connecting direct radiators into a system does not differ in principle from that required for making similar connections to other steam-using equipment. As these radiators are for gravity flow of air they do not condense steam so rapidly that special traps have to be used with them and in this particular their requirements are much like those of gravity convectors. Some more or less standardized methods of erecting and arranging piping have come into use with direct radiators and some of these are illustrated in the accompanying sketches.

These several sketches are all to be considered as typical and not exact for they are not to scale. In all cases it should be kept in mind when following these sketches that the piping layout must provide for escape and disposal of air and condensate as well as for the provision of a supply of steam to the radiator. As air and condensate are led out of the radiator in ways which are peculiar to the various systems of heating, the methods of connection differ somewhat with the system used. As in the case of all other steam-using equipment, piping to the radiators must be in accordance with the system requirements and must not interfere with the proper operation of other equipment attached to the same piping.

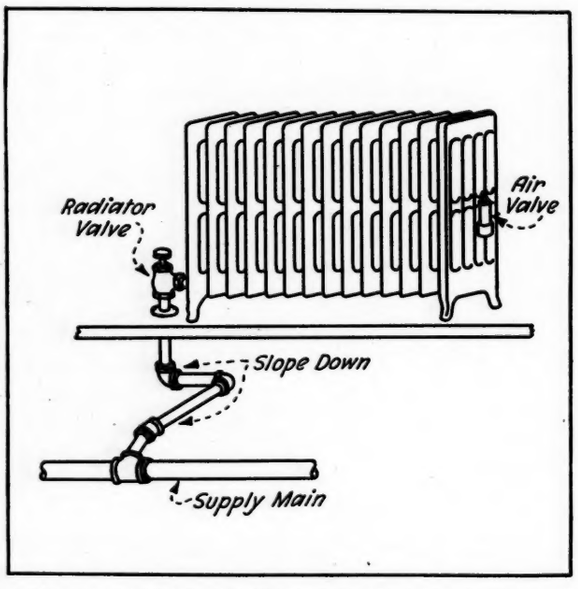


Fig. 1. Piping for a simple one-pipe system with all radiators on one floor and main in basement.

Figs. 1, 2, and 3 illustrate methods of piping between the steam main and the radiator in one-pipe installations. Here there is but one pipe fastened to the radiator and a distinctive feature is that the only path provided for removing air is through the air valve. The condensate has to pass out through the same opening through which the steam enters, and consequently the steam pipe must be designed and erected with sufficient care to insure that operation takes place as intended. To a considerable extent this depends on providing a large enough pipe but careful erection is also important and especially is it important that the slope of the pipe be sharp enough so that the condensate can move along the pipe by gravity flow.

Fig. 1 indicates probably the simplest case and also probably the one of most frequent occurrence with one-pipe installations. Note that the connection to the main is made at the top and that the sketch calls attention to the necessary direction of slope. Usual recommendation is that the pipe slope just as steeply as dimensions will permit and that it should never be less than ¼ in. per foot of pipe length, a slope corresponding to a 2% grade. Figs. 2 and 3 present the less

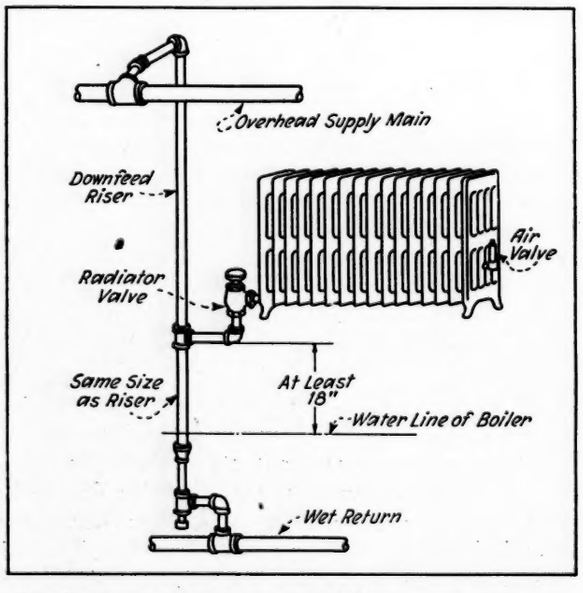


Fig. 2. Overhead supply main and basement wet return main with a single-pipe connection to radiator, showing minimum water line clearance.

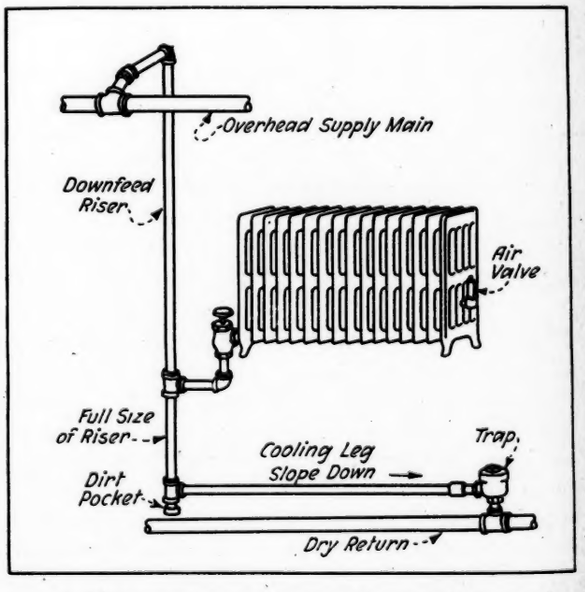


Fig. 3. Pipe arrangement commonly used with one-pipe systems having overhead supply main and basement dry return main.

for Direct Radiators

usual case in the one-pipe system where the supply is overhead. It should be noted that, as in Fig. 1, the connection from the main is taken from the top. The vertical pipe is run full size past the radiator connecting pipe and leads by as direct a route as possible to the return which has to be below the lowest steam-using equipment attached to the system. In Fig. 2 is indicated the necessity of keeping the bottom of the pipe leading to the lowest piece of steam-using equipment at least 18 in. above the normal boiler water-line when there is a wet return. Neglect of this important dimension is a frequent cause of trouble. Also in Fig. 3 a cooling pipe is indicated ahead of the trap which is intended to pass all the condensate as rapidly as formed. This cooling pipe should be not less than 5 ft. long to insure the expected operation.

Figs. 4, 5, 6, and 7 show typical arrangements of the piping with two-pipe systems of various kinds. Since two pipes—one for the supply and one to accommodate the air and condensate—are connected to the radiator and since openings are provided at both ends, top and bottom, it is possible to connect the piping about as desired so long as the return pipe is attached to a bottom opening in all cases. Thus in Fig. 4 the supply is at the top and the return at the opposite end, in Fig. 5 the supply and return are bottom of opposite ends, in Fig. 6 the supply and return are top and bottom of the same end. These locations of the piping are largely open to no other considerations than convenience and appearance, and the flexibility thus made possible can be turned to advantage in many cases.

Figs. 4 to 7 are not intended to give the impression that these locations of the supply and return pipes can be used only with the particular locations of supply and return mains shown. Rather the sketches have been selected to show a variety of typical cases and to illustrate the great flexibility possible with two-pipe arrangements. Fig. 4 shows a case of common occurrence when there is but one floor and the mains are

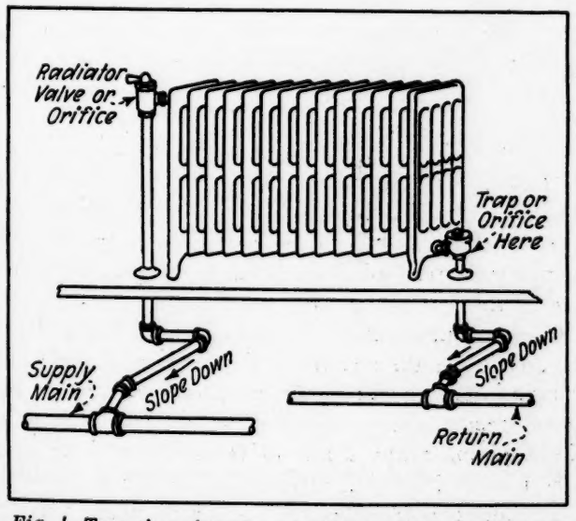


Fig. 4. Two-pipe steam connections with supply at top and return at bottom at opposite ends of radiator.

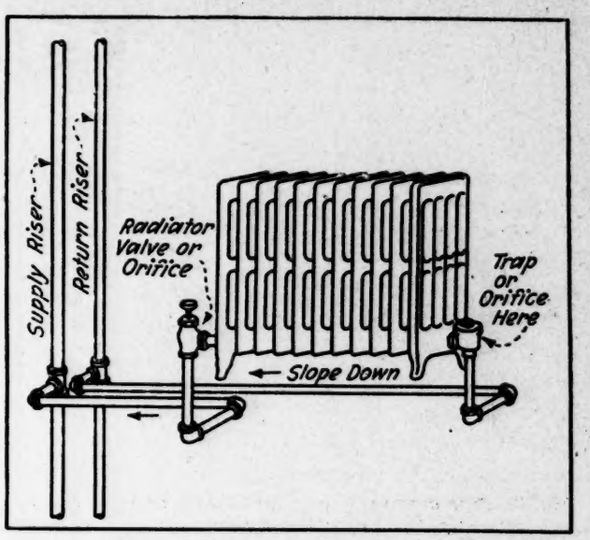


Fig. 5. Connection between risers and radiator on two-pipe systems with supply and return at bottom openings in opposite ends of radiator.

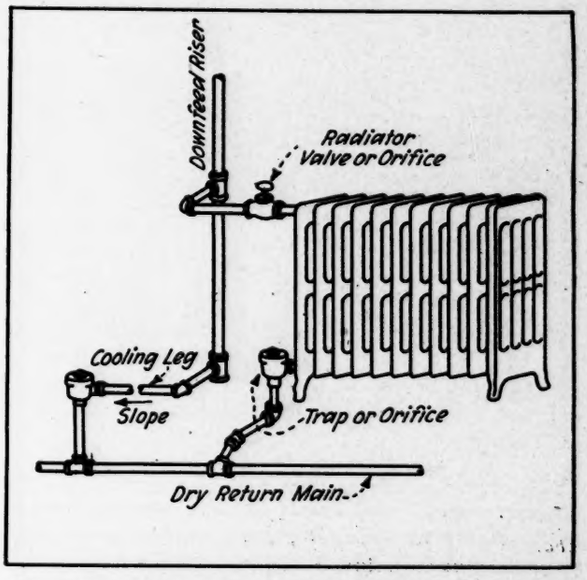


Fig. 6. Downfeed riser and radiator separately trapped on two-pipe system, radiator connections top and bottom of same end of radiators.

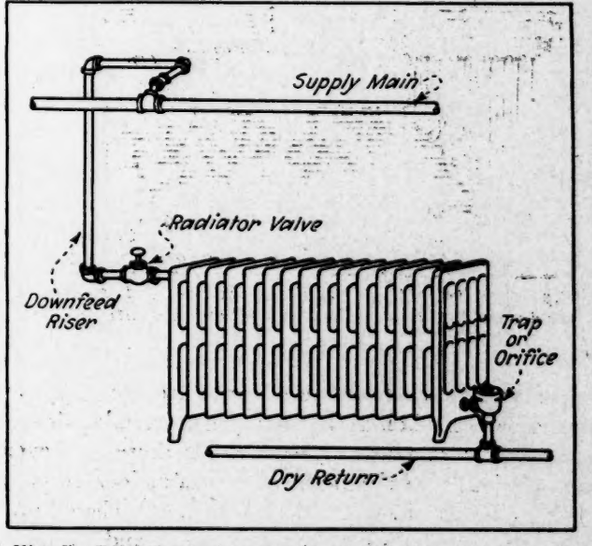


Fig. 7. Downfeed riser and radiator drained through one trap on two-pipe steam system.

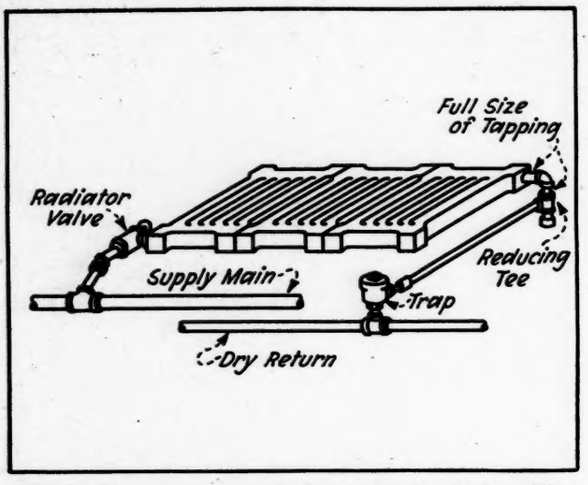


Fig. 8. Pipe arrangement where radiator is in ceiling and but slightly above supply and return main on two-pipe system.

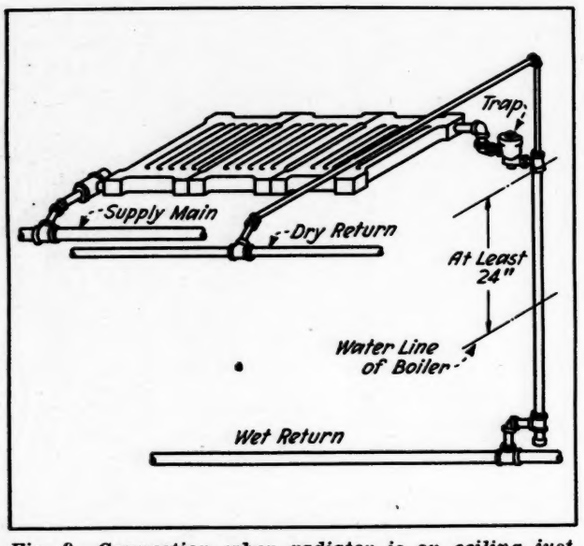


Fig. 9. Connection when radiator is on ceiling just above mains and when there are both wet and dry return mains on two-pipe systems.

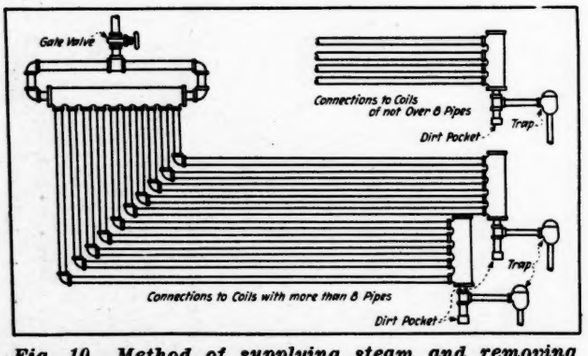


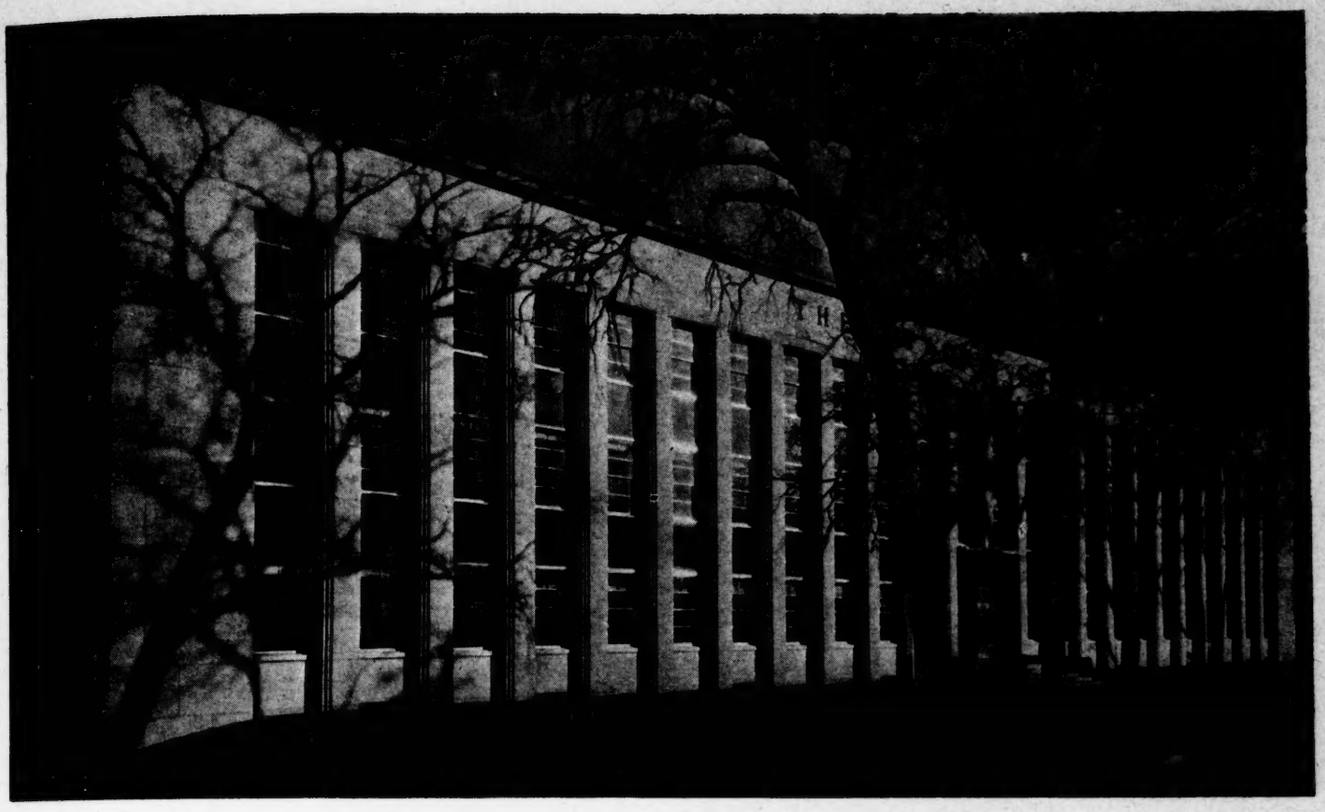
Fig. 10. Method of supplying steam and removing condensate and air when steam supply rate is high.

located in a basement. Here slopes are important and their direction should be observed carefully. Fig. 5 is a case of common occurrence when there are several floors all fed from the same set of mains located either above or below the radiators. The sketch shows especially the piping details between risers and radiators. The horizontal pipes can be located either above the floor, in the floor, or below the floor as convenience or necessity indicates on any particular installation. In cases of this kind a simple arrangement of piping can be secured by choosing the top and bottom location for the radiator pipes as indicated in Fig. 6.

A significant point is illustrated in the difference between Figs. 6 and 7. It will be noted that in both these sketches the supply is overhead while the return is located below. In Fig. 6 two traps are used—one to drain the radiators and the other to drain the riser. The arrangement of Fig. 6 is the one commonly considered suitable where the riser is long, as when several floors are served from one overhead supply main. The arrangement of Fig. 7 necessitates a special radiator valve designed to permit condensate to pass through readily since, it will be noted, all condensate from the main must pass through the valve and ultimately find its way through the radiator trap. The particular point is that no matter what path may be provided for the condensate, a definite and positive arrangement should be included in order that there be no accumulation of water anywhere in the steam piping. This would occur if the arrangement of Fig. 7 were used with no means for the condensate from the riser to pass through the valve and reach the trap.

Occasionally, in basement locations especially, radiators must be attached to the ceiling in order to secure gravity flow of condensate to return mains. Figs. 8 and 9 illustrate methods of connecting such radiators to mains of two-pipe systems. Fig. 8 applies to cases where there is a dry return pipe only and where a trap is used to keep steam out of the return pipe. In this case it is desirable to locate the trap close to the return, as shown, rather than close to the radiator outlet in order that the connecting pipe between radiator and trap may be as long as possible—and at least 5 ft. in any case—to permit steam to condense and the condensate to cool before coming in contact with the trap thermostatic element. In the arrangement shown in Fig. 9 the trap is shown located where convenient to accommodate both the pipe which leads the air to the dry return and the one through which the condensate falls to the wet return. In this arrangement the air and condensate separate immediately after passing through the trap and are disposed of through separate pipes. The figure also illustrates the important relation between the height of the boiler water-line and the bottom of the lowest pipe connecting the radiator to the return piping.

Fig. 10 is of more importance as illustrating a principle than as showing detailed connections. It will be observed that the supply is split just before entering the radiator and that steam is fed to the radiator at two points instead of one. This is a means of getting more steam to the radiator than would be possible with a single opening of fixed size and one which at the same time distributes the steam supplied over the whole supply manifold. Similarly, the radiator is served by two traps instead of one. This method is followed in principle in piping many kinds of steam-using equipment where the condensation rate is high as, for example, in central fan coils or where the supply of steam must be great.



Exterior of office building of Upjohn Co., Kalamazoo, Mich.

All-Year Air Conditioning Used by Manufacturer of Medicines

By F. O. JORDAN†

ONE of the very important factors responsible for the recent growth of air conditioning is the beneficial influence of maintaining certain air conditions for many of the processes used in the manufacture of medicine. Without air conditioning the quality of certain products is seriously affected. In fact, many processes are impossible under natural conditions during most of the year so that some products cannot be made without air conditioning at all, except during very limited periods.

Problems in Pairs

There were a number of unusual problems in connection with the design and installation of the summer and winter air conditioning equipment in this plant, not only because of the many types of comfort and process conditioning to be done and of the wide variety of conditions necessary to be maintained, but also because various methods of air conditioning were required. A rather striking feature about these problems is that so many of them came in pairs. Some of these pairs of problems were as follows: First—there were two kinds of air conditioning, comfort and process; second—there were two kinds of comfort to be considered, human and animal; third—the comfort of two seasons was considered, summer and winter; fourth—two kinds of summer air conditioning systems were installed, well water and mechanical refrigeration; fifth—two types of heat transfer surfaces were used, air washers and surface convectors; sixth—two types of winter conditioning systems were installed, direct and indirect; seventh—two types of summer conditioning systems were installed, direct and indirect; eighth—there were even two types of buildings to be air conditioned, a factory and an office building.

Each of these problems demanded individual consideration and was solved by using methods and equipment suited to its particular requirements. The systems eventually decided upon and installed were the result of the collaboration between the engineers of the Upjohn Company who had made an intensive study of the requirements of their processes, and the engineering department of Albert Kahn, Incorporated, whose extensive experience made it possible to meet the requirements of the process men.

Comfort Air Conditioning

The importance of air conditioning for the comfort and health of human beings is too well known to re-

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quire further elaboration because everyone is fully aware of the influence upon the well being of humanity of the condition of the environmental atmosphere. But comfort air conditioning at Upjohn is not limited to maintaining comfort for the human occupants of the buildings. One of the important usages of air conditioning is to maintain health and comfort for the rats —as well as for other animals kept for the purpose of studying the effects of disease germs and cures of diseases upon animal life.

Process Air Conditioning

The importance of process air conditioning becomes evident when we realize that many processes required in manufacture of drugs are possible only when the temperature and humidity of the air are maintained within very limited ranges. For this reason, it is impossible to conduct many processes during a considerable portion of the year. Furthermore, there are many other processes that are greatly facilitated and many medical products greatly improved if the proper air conditions are maintained. These conditions relate not only to the temperature and humidity of the air but also to its purity and to its freedom from dust and germs.

Many types of drugs, especially those in powdered form, and capsules used for containing powders, not only absorb moisture from the atmosphere very readily, but become sticky or cake so that they cannot be handled when they absorb only slight quantities of moisture. Certain drugs tend to melt or lose their proper consistency at high temperature also. For these reasons, air conditioning is of almost inestimable value in the drug industry. For processes in drug manufacture where air conditioning is required, a condition of 70 to 80F dry bulb temperature and 30% to 35% relative humidity covers the range of requirements.

When making pills and tablets, a dry bulb temperature of about 80F with relative humidity ranging between 35% and 45% is satisfactory. At high humidities, tablets and pills cannot be formed or molded. Certain tablets which give off large quantities of carbon dioxide when submerged in water require a dry bulb temperature of about 90F and a relative humidity of about 15%.

The coatings for pills must be cooled and dried after the pills are dipped. If the rate of cooling and drying is too low, the coatings become rough and almost translucent. If the coatings are cooled and dried too rapidly, they will chip. Powders used for coatings will not adhere properly at excessive humidities, although humidity should be kept below 35% in order to prevent the particles from adhering to metal containers because of static electric charges.

Before air conditioning came into use in drug manufacture, gelatin capsules could not be made during very dry winter weather. If too warm, the gelatin will flow by gravity, so that capsule walls vary in thickness, while the gelatin will not flow readily, and the capsules will be too thick, if temperatures are too low.

Many drugs are made from glands and other parts of animals. These parts lose their medicinal value if processed at temperatures very much above 75F.

In addition to the temperature and moisture requirements of the air used in connection with drug manufacture, the cleanliness of the air is of special importance also. For this reason, the cleaning function is one of the important ones in this type of work.

Winter heating of this three-story structure is accomplished by means of concealed copper steam radiation supplied with low-pressure steam from overhead mains located in the attic. Condensate from the radiators is collected into underground return mains. In addition to the direct radiators, ventilating systems are installed which distribute conditioned air throughout the office spaces. This air is heated by extended fin type blast heaters and humidified by means of air washers. The direct radiation system is designed to balance the heat loss from the building, while the ventilation system blast heaters are designed to carry the ventilation load only, and to heat the air up to a few degrees above room temperatures.

Each floor of the office building is divided into five control zones. The steam supply to each zone is controlled by means of a pressure regulating valve positioned by a thermostat located within the zone so that the steam pressure is maintained at the level required. The condensate returns are of the vacuum type, the vacuum pump being operated under control of a differential vacuum controller with the result that a constant differential is maintained between the pressure or the vacuum in the return system and the pressure or vacuum in the steam supply system. The controls are actuated by compressed air supplied by a conventional pneumatic temperature control system. Orifices are installed at steam supplies to radiators as necessary to secure proper steam distribution according to the size of the radiators.

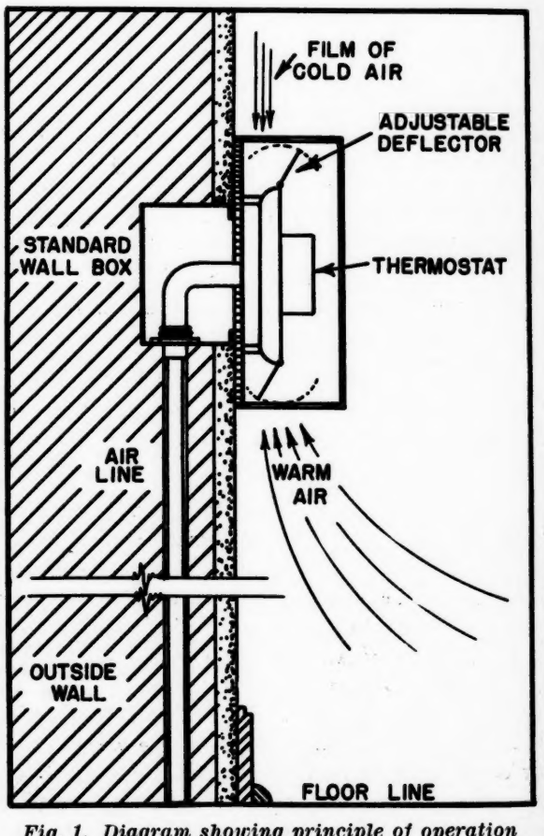


Fig. 1. Diagram showing principle of operation of infiltration thermostat.

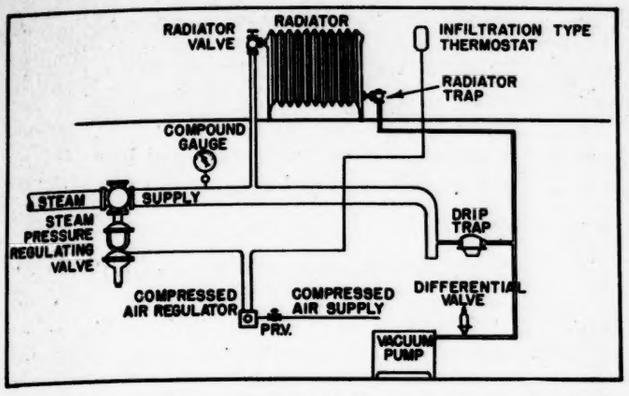


Fig. 2. Control system with thermostat regulating steam pressure at reducing valve.

As mentioned, steam pressure is regulated to suit the outside weather conditions so that even temperatures are maintained regardless of the weather. When outside weather conditions are very severe, the zone thermostat sets the valve controlling the steam pressure in the zone so that a pressure of about 3 lb. per sq. in. is maintained throughout the system. This steam pressure corresponds to a temperature of 221F, and a specific volume of steam of 22 cu. ft. per lb. As outside weather conditions become milder, the steam pressure is automatically reduced in such a way that the heat loss from the zone is balanced exactly while the system is entirely filled with steam. Steam pressure is reduced as the outside weather becomes more mild until a pressure equivalent to 25 in. of mercury vacuum is maintained throughout the system. This vacuum corresponds to a temperature of 133F and a specific volume of 146 cu. ft. per lb.

If the outside temperature rises until a further reduction in steam pressure and temperature would be required, steam is supplied in intermittent "shots."

A unique feature of the temperature control in this building is the zone thermostats mounted on the outside instead of the inside walls according to conventional practice. One of these thermostats is shown by Fig. 1.

The idea behind locating the thermostat on the outside wall is that it will be affected by the combination of outside temperature, wind, and sun effect in the same degree that the heat loss from the building is affected by those outside conditions because it is located at a point where such losses take place. Research has shown that a current of cold air descends along the inside surface of outside walls in direct proportion to the heat loss through the walls, and that a current of warm air rises just inside the falling current of cold air. Therefore, the infiltration thermostat is mounted upon the outside wall within a housing open at top and bottom so that the rising and falling currents near the surface of the wall circulate through it and contact the thermostatic element. Dampers are provided which can be adjusted so that the warm and cold air streams pass through the housing in the proper proportion to affect the thermostatic element in proportion to the rate of heat loss through the wall.

This thermostat is connected by means of a pneumatic control line to an automatic flow control valve of the modulating type so that steam pressure in the heating system is regulated according to the heat loss from the zone. A diagram of this control system is shown by Fig. 2.

The vacuum pump is of the "split" type in which separate pumps are used for pumping condensate from the return system and for evacuating it of air and maintaining the required vacuum.

A feature of the underground return system is that return mains are made of iron pipe-size brass pipe with soft copper tubing branches located underground beneath the floor in tile.

Summer Conditioning of Office Building

The same ventilating systems, consisting of fans, air washers, and ducts, are used for distributing conditioned air throughout the building in the summer as in the winter. Air is supplied through circular air supplies of the directional type located in the ceilings so that air is distributed in a thin sheet in all directions at the ceiling. The spacing of supplies and the velocity of air supply are selected so that complete coverage of the entire room area by conditioned air may be accomplished above head height to avoid noticeable drafts.

The air is cooled and dehumidified as required by being circulated through air washers into which city water is sprayed. Since the city water is maintained at about 55F because it is drawn from wells at somewhat lower temperatures, dehumidification as well as sensible cooling of the air is accomplished. Of course, lower water temperatures would be required for air conditioning loads for theaters and similar projects of heavy latent ratios. However, the temperature at which city water is supplied in Kalamazoo is satisfactory for sum-

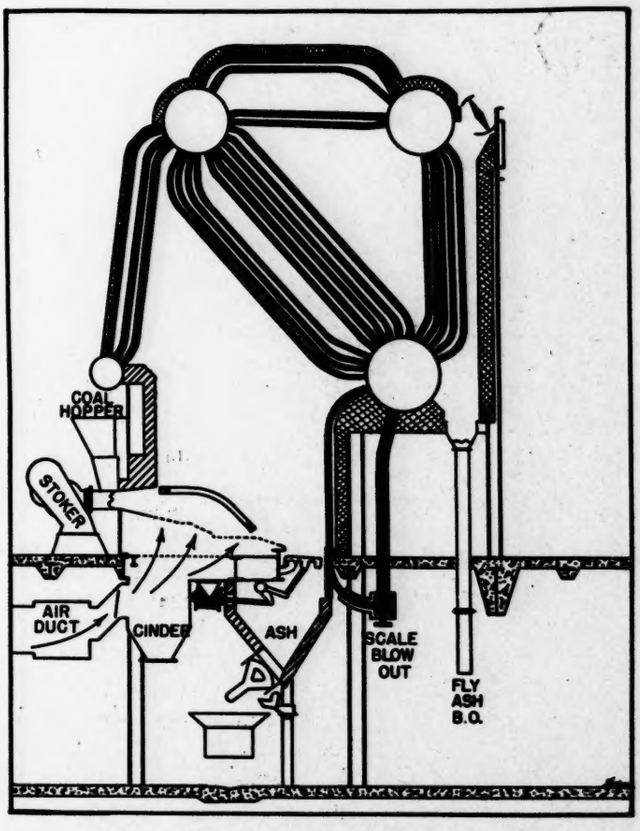


Fig. 3. Section through boiler, stoker, and ash disposal equipment.

mer air conditioning of office spaces and similar applications where the latent ratio of a load is not particularly heavy.

Since the infiltration thermostats respond to the rate of heat gain in the summer resulting from the existing combination of outside temperature, wind, and sun effect, they are used for controlling operation of the summer air conditioning equipment as well as the operation of the winter equipment.

Winter Conditioning of Factory Building

The factory building is six stories high with a 13-story tower. Steam mains are installed in a pipe space above the third story, and feed up and down to radiators on the floors above and below respectively, while radiators are of cast iron type.

Each story of the main portion of the factory building is divided into eight control zones. Each of these control zones is provided with a modulating type flow control valve operating under regulation of an infiltration thermostat as described for the office building.

Ventilating systems are provided in the factory building consisting of fans, blast heaters, and air washers as in the office building.

Summer Conditioning of Factory Building

Air conditioning of the factory building in summer is accomplished as described for the office building, except for process air conditioning systems in departments where the latent ratio of the load is too heavy for the temperature at which city water is supplied. In such locations where lower temperatures are required, the air is cooled and dehumidified by means of surface type direct-expansion coils, except in the basement storage space where refrigerated brine is circulated through indirect forced-convection cooling units.

Boiler Plant

A complete boiler plant containing two stoker-fired water-tube boilers is provided for generating steam for heating and process usage, and for distilling the enormous quantities of water used in the processing of the various drugs and medicines prepared in this plant.

The boilers are of the bent-tube type. Radiant type boiler fronts or water screens are installed at the front of the combustion chambers, and water screens are provided also at the bridge walls. Stokers are underfeed with steam-driven, forced-draft fans.

Coal is supplied to the stoker hoppers from overhead bunkers by means of weighing larries. The coal is elevated to the bunkers and distributed through them by continuous bucket type conveyors. Ash and clinkers are collected in hoppers beneath the boilers when dumped from the stokers by means of steam-ram operated ash dump gates. From the ash hoppers the clinkers and ash are dumped into a car in which they are removed.

Fig. 3 is a section showing the boiler and stoker installation, and the ash hopper and dump.

Premier Chamberlain Installs Modern Heating System

THE official London residences of the British Prime Minister and the Chancellor of the Exchequer at 10 and 11 Downing Street have long been considered uncomfortable and old-fashioned headquarters for such important personages. No. 10 has been the official residence of 39 Prime Ministers since 1735, and the majority of them have complained about its discomforts. Sir George Downing was partly responsible for the building, and the famous Sir Christopher Wren and Sir John Soane made alterations and additions to it. But its discomforts remained. The stone kitchens were built later than Downing's time and it is said that William Pitt was responsible for the immense fireplaces. As Pitt was fond of entertaining 50 people at a time, he probably used the fireplaces for roasting at the spit.

Not until Neville Chamberlain became Prime Minister, however, was the complete modernization of the official residence undertaken. The necessary work has now been completed and, apart from the entire renovation of No. 10, it includes extensive alterations to Nos. 11 and 12, the latter an adjoining building used by high officers of state.

In the boiler house at 10 Downing Street three gas-fired hot water boilers have been introduced for central heating purposes. These boilers operate 100 radiators of varying sizes in Nos. 10, 11, and 12.

A special thermostat regulates the temperature in the Cabinet Room, which has a temperature recorder on the table. A time switch shuts down the central heating plant at 10 o'clock each night and starts it up again at 6 a.m. The hot water pipes are concealed and the radiators are fitted into recesses below the windows.

In the Prime Minister's dining room 10 radiators are concealed behind panels. There are radiators and heated towel rails in the many bathrooms throughout the house. In addition, there are a number of attractively tiled fireplaces designed for gas "fires."

An interesting job has been done in several of the rooms of the Chancellor's house at No. 11 Downing Street. Old fireplaces with cast iron surrounds have been pulled down and a gas heater in an antique steel basket grate with dogs has been fitted into each setting. The effect is that of a glowing open coal fire. A switch at the side of the mantelpiece turns on the heater and is placed at the correct height to obviate stooping. These gas "fires" are fitted in the entrance hall, Chancellor's Room, dining room, library, drawing room, afternoon tea room, and boudoir.

Gas heaters have also been fitted in the secretary's office and bedroom, Lady Simon's study and bedroom, Chancellor Simon's bedroom, and two guest rooms. In the basement five gas heaters have been fitted in the butlers', footman's and servant's hall, cook's room and butler's pantry.

Thanks to these heating and other improvements, Downing Street's most famous residences have been raised to a level of comfort never before known in their 200 years' history.

Air Conditioning Reduces Tarnishing of Silver in Jewelry Store

WHEN the 117-year old A. Stowell Company of Boston, jeweler, silversmith and dealer in high grade gift merchandise, installed year-round air conditioning some months ago, the thought uppermost in the mind of the management was comfort for customers and employes.

Other practical benefits have developed, however. Much time and money have been saved in keeping the large amount of silverware in stock and on display clean and free from tarnish, as well as keeping clean the other merchandise. No longer do clerks have to spend hours polishing silver that has become coated with a fine film or fog deposited while the store was closed overnight, in spite of air-tight showcases.

Such tarnish or fogging is inevitable in a large city, with its smoke and soot, and, in the case of Boston, east winds frequently blowing salt air in from the Atlantic Ocean. Often pieces had to be returned to the manufacturers for repolishing, after a period of damp, foggy weather. This tarnishing has been eliminated by humidity control and also because the air washer removes sulphur from the air. Also fogging or steaming up of the windows caused by condensation has been eliminated during damp or extremely cold weather, when outside temperature is considerably lower than that within. While no figures have been kept as to savings effected in cleaning time and reduction of tarnish, the management is well satisfied with the results.

The Stowell Company was established the same year that Boston became a city. It is housed in a building which tradition says is well over two hundred years old, although it has been modernized and remodelled several times in keeping with modern business ideas prevailing at the time of remodelling. Today it is a handsome structure, faced with marble and bronze metal, two stories high with a setback of two more stories and a curious sort of penthouse at the top rear.

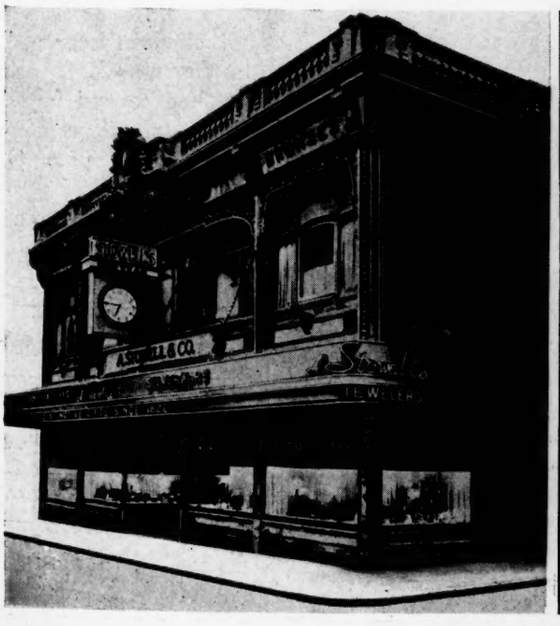
From the very nature of its structure and its location on a narrow street, the store has often been uncomfortable on very hot days for shoppers. It was to overcome this drawback and provide comfort for customers that this air conditioning system was installed.

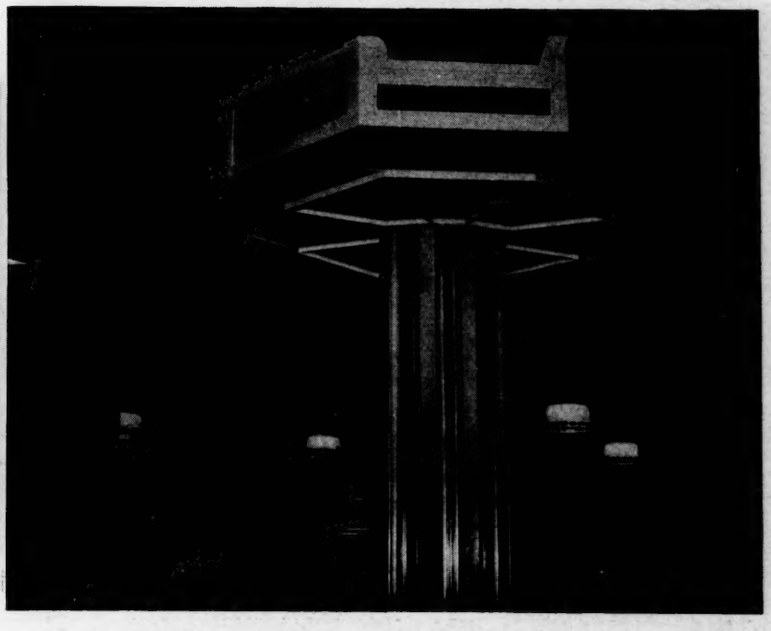
Except for a 10-hp. refrigerating compressor in the basement, all the conditioning equipment is housed in a sheet metal cabinet on the second floor directly over the center of the main store and over the distributing chamber attached to the ceiling of that floor.

It is a compact arrangement, affording perfect rotary diffusion of conditioned air to all parts of the main store street floor and through a separate outlet to two salesrooms on an L wing.

Air is drawn through an outside duct extending above the second-story roof, through a double bank of filters and then passes through the conditioning chamber and over heating or cooling coils. The refrigerant lines are brought up from the basement through an insulated conduit, while steam is supplied to the coils from the Edison underground system. A 3-hp. fan circulates the air over heating and cooling coils and through the conditioned area by means of the distributing chamber on the ceiling of the floor below.

Total air handled is 6500 c.f.m. of which approximately 25% is outside air. An economizer control regulates the amount of outside air introduced, which can





(Left) The A. Stowell Company jewelry and silversmith establishment in Boston. The building is believed to be at least 200 years old. (Right) The octagonal plenum chamber and supply grilles inside the store.

be brought up to 100% if desired. From the conditioning chamber the air passes through three extremely short floor ducts to an octagonal chamber below, with sufficient pressure behind it to diffuse it to all parts of the main selling floor.

The diffusing unit, which was specially designed to harmonize with the fluted pillar which it surrounds is thus really a pressure chamber. Air is distributed through eight aspirating grilles in the upper part of the octagonal chamber, while return is from a lower section through which the air is drawn up through the center of the chamber into the conditioning unit for reconditioning and recirculation. Return openings are entirely concealed by the lower octagonal plaque.

Relative humidity is designed to be maintained at approximately 35%. A windowstat controls humidity in the show windows and keeps away condensation from the glass.

The control system consists of the following: (1) a cooling cycle automatically controlled by operation of a thermostat located in the conditioned area, which actuates a secondary circuit on the starter, to start or stop the compressor as desired; (2) winter temperature control—by means of a thermostat located in the return duct, actuating a motorized steam valve which is placed in the steam supply to the heating coil. In addition a low limit thermostat in the discharge duct of the unit serves as a low limit control, to eliminate the possibility of low temperature air being distributed to the conditioned area. The system also has an economizer control for both winter and summer operation so that larger amounts of outside air can be utilized when outside temperatures are such that more economical operation can be made by using more outside air.

The contractor was General Heat & Appliance Co., and the engineer was K. D. Boucher of that company.

Study of Air Temperatures at Different Room Levels

OVER the past 12 years HEATING & VENTILATING has published at various times brief articles describing the experiences of Harry A. Ward of Ithaca, N. Y., in the heating of his home at 206 Elmwood Ave., Ithaca.†

Recently Mr. Ward was seeking information on low temperatures at various levels during severe weather and finding but few of these he took advantage of the cold weather this heating season to check the levels in his residence. The outside temperatures ranged from 0 to 10F. Temperature readings were taken at the floor and at 3, 5, and 7 1/3 ft. above the floor. The floor temperatures ranged from 61 to 65F with corresponding 5-ft. temperatures of 71 to 72F. The readings are tabulated below.

The house is 28 x 30½ ft.; cellar, first, and second floors have 8¼-ft. ceilings, and the attic is unheated. The side walls are of stucco on metal lath sheathing and the spaces between the studding are filled with glass wool, blown in, plaster board and plaster. The ceiling of the second floor is plaster on plaster board with 2½ to 3 in. of mineral wool between floor joints. Eleven of the 20 windows in the house are fitted with storm sash.

The living room is 16½ x 15½ ft., with 8 ft. 3 in. ceiling, two 5 ft. x 2 ft. 7 in. windows with storm sash, one 5 ft. x 3 ft. 8 in. window without storm sash. The temperatures reported were taken at the middle of the room. The wind at all times was moderate.

The heating system consists of 375 sq. ft. of cast iron hot water radiator surface. No. 1 Buckwheat is burned.

In the accompanying tabulation, Columns E, H, and I were taken just after thermostat had started forced draft fan. Columns F, J, and P were taken just after thermostat had shut off forced draft fan. Columns G, K, and L were probably affected, at least at floor temperature, by blocks of cold air drained from sleeping rooms by the opening of the doors, after closing the windows opened during the night.

†These articles in HEATING & VENTILATING were: (1) Heating Ten-Room House with No. 1 Buckwheat Coal, October, 1927; (2) Accuracy of Degree-Day Basis for Figuring Coal Consumption, January, 1928; (3) Fuel Savings Resulting from Insulation of a Residence, September, 1937.

TEMPERATURE AT DIFFERENT LEVELS ON JANUARY 25, 1939

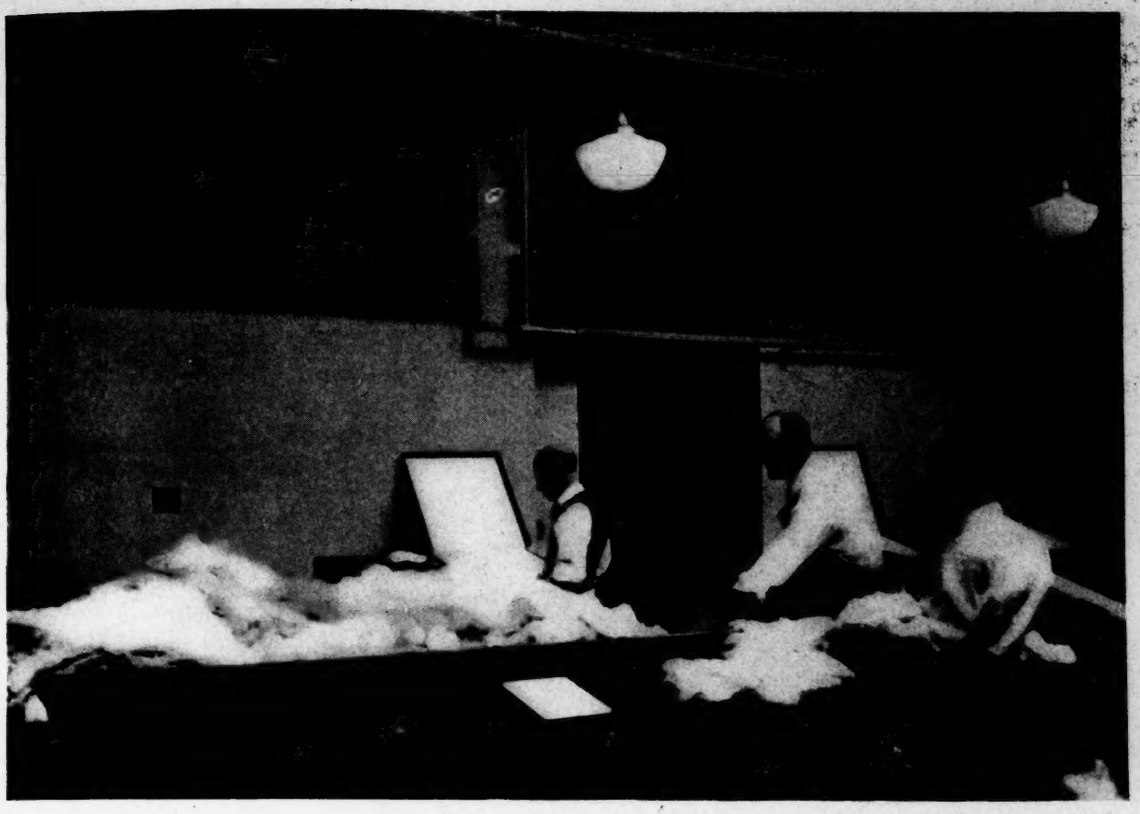
Temperature Reading, Ft. from Floor	Time, P.M.					
	6:45	7:00	7:20	7:45	8:30	9:30
	Column					
	A	B	C	D	E	F
	Temperature, F					
At Floor	64	65	64	64	62	64
3	66	69	68	68	66	68
5	73	72	72	72	70	72
7 1/3	—	73	72	72	70	72
Thermostat ...	72	—	72	72	70	72
Outside Temp..	4	5	5	5	5	5

TEMPERATURE AT DIFFERENT LEVELS ON JANUARY 26, 1939

Temperature Reading, Ft. from Floor	Time			
	8:00 a.m.	6:30 p.m.	9:15 p.m.	10:20 p.m.
	Column			
	G	H	I	J
	Temperature, F			
At Floor	62	64	64	64
3	66	68	66	68
5	72	70	70	71
7 1/3	73	72	72	74
Thermostat ...	72	70	70	72
Outside Temp..	4	10	8	6

TEMPERATURE AT DIFFERENT LEVELS ON JANUARY 27, 1939

Temperature Reading, Ft. from Floor	Time					
	7:40 a.m.	8:00 a.m.	12:45 p.m.	7:00 p.m.	7:30 p.m.	8:30 p.m.
	Column					
	K	L	M	N	O	P
	Temperature, F					
At Floor	60	61	64	65	65	66
3	66	67	69	70	69	71
5	71	71	72	72	70	73
7 1/3	74	74	74	72	71	74
Thermostat ...	71	72	72	72	71	73
Outside Temp..	0	0	20	20	20	20



One of the four Cotton Classing Rooms which are conditioned with a combination system consisting of wall type heat transfer coils and separate humidity control apparatus.

Cotton Testing Laboratory Completes an Outstanding Air Conditioning System

By JOSEPH F. KERN, JR.†

Three of the most unusual air conditioning systems that have ever been installed have been just completed in the Department of Agriculture's Annex building in Washington, D. C. The laboratories which are air conditioned by these systems are used by the Cotton Marketing Division in connection with its work in developing standards for and the classification of raw cotton. There are eight laboratories in all, conditioned by three entirely separate air conditioning systems. One of these rooms is a special research laboratory and the air conditioning installed is able to maintain any temperature between 32F and 100F with any relative humidity from 10 to 97 per cent with an air motion of not over 6 ft. per min. Some other unusual features of the equipment installed in these laboratories are first, six of the rooms are cooled to 70F using well water which has a temperature from 60 to 62F, second, in some of the rooms the air temperature maintained is only 1F above the water temperature in the cooling coils and third, the relative humidity in these laboratories is indicated and recorded with an accuracy of within 1/10 of 1 per cent

IN connection with the United States Department of Agriculture's cotton quality standardization and classification work, including service, regulating and research phases, probably more innovations are incorporated in the air conditioning systems installed in the Department's Annex Building, 12 and C Streets, S.W., Washington, D. C., than in any air conditioning installation in recent years. To name just a few of the unusual features: first, a room 15 ft. long, 13 ft. wide and 12 ft. high, in which it is possible to maintain any temperature from 32 to 100F within one degree plus or minus, any humidity from 10 to 97% within one per cent plus or minus and to have an air motion of less than 6 feet per minute; second, the indicating and recording of the relative humidity directly in a remote location with an accuracy of one-tenth of one per cent; and third, the cooling of rooms with only one degree difference in temperature between the room air and cooling medium.

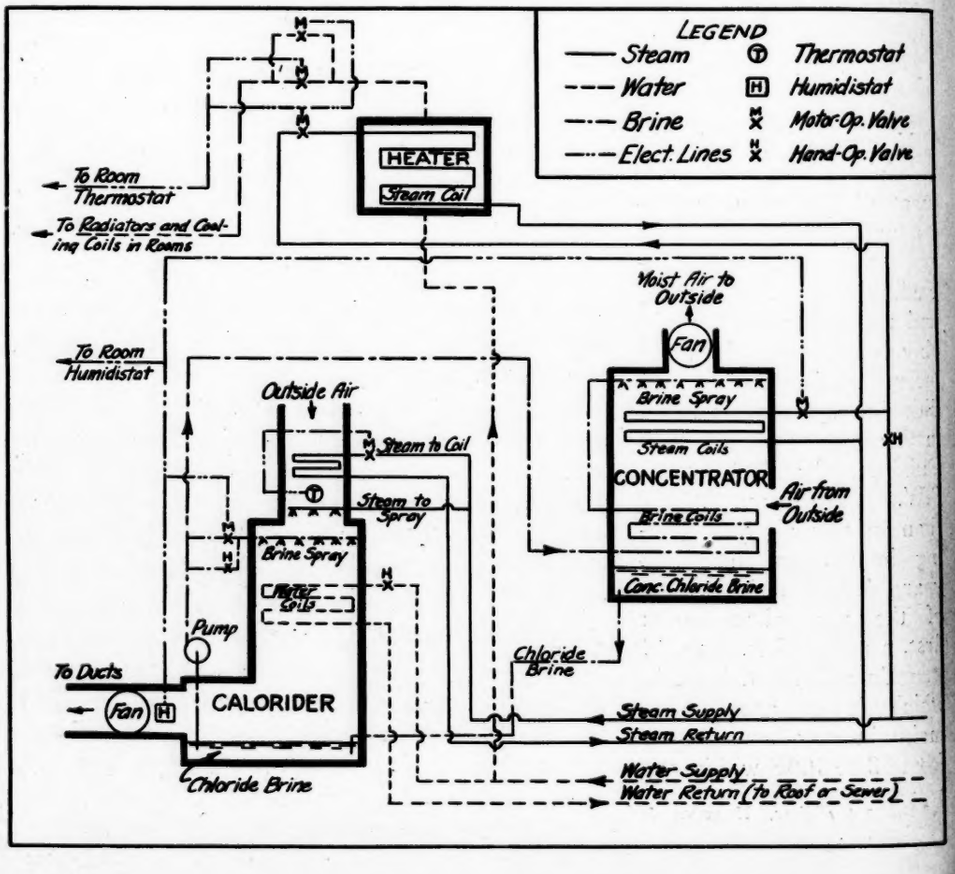
The air conditioning systems, incorporating these unusual features, are used to maintain the proper conditions in four cotton classing rooms and four cotton research laboratories of the Cotton Marketing

†Assistant Editor, HEATING & VENTILATING.

Cotton Classing Room air conditioning system during construction. At the left is the chloride brine concentrator with the outside air inlet at the bottom and moist air discharge duct at top. In the center is the Calorider and conditioning unit with the outside air coming in through duct overhead at left and the conditioned air leaving through fan and duct at right. Insulation and controls were not installed when picture was taken.

Division of the Bureau of Agricultural Economics as a part of the facilities and program needed for better handling the Department's statutory responsibilities with respect to cotton. This Division was organized "to inspect, sample and classify cotton"; "to establish and promulgate standards of cotton by which its quality or value may be judged or determined, including its grade, length of staple, strength of staple, color and other such qualities, properties and conditions as may be standardized in a practical form," and to "prepare practical forms of the official cotton standards . . . and to furnish such practical forms to any person requesting the same."

In other words this Division of the Department of Agriculture has to set up standards by which raw cotton may be judged, furnish standard samples of cotton to anyone requesting them and to classify particular grade and staple lengths of cotton when requested.



Schematic diagram of the conditioning unit which serves the four Cotton Classing Rooms. The Calorider at the lower left supplies air at 66F and whatever relative humidity that is necessary to the four Cotton Classing Rooms. The concentrator at the right is used for removing the excess moisture from the chloride brine. A photo of this equipment is shown above.

How Cotton is Classified

Cotton is classified by men known as cotton classers who have grown up in the business and have had long years of experience in determining the grade, staple length and character of cotton by sight and feel only. Cotton classing is an old and intricate art and cotton classers can obtain proficiency only by long, tedious and laborious experience. Their work involves a delicate sense of touch because the feel of the cotton has much to do with the classer's judgment of fineness and strength and also of length. It involves a keen sense of sight and keen judgment because the classer has to estimate by sight the fine shades of color and the amount of foreign matter. It requires accurate memory because the basis of classification is a series of several hundred samples involving over 50 steps in grades of cotton which may or may not be available and in the presence of the classer at the time of classification.

Since the passage of the Cotton Future's Act and Cotton Standards Act it has been the purpose of this Division to study and learn as much as possible about the properties of cotton so as to help the classer in his work. It is hoped that eventually it will be possible to supply these men with sufficient detailed information so that classification may be done on a scientific basis, that is by actual measurement and comparison with standard samples.

In order to prepare the standards it has been necessary to do a tremendous amount of work to determine just how the various grades of cotton differ and to determine the effect of the various properties on the ultimate utility of the raw cotton.

Much remains to be done in research on the nature of cotton, in defining and measuring its properties and

in determining how such properties may be establishing the qualities desired in articles made from cotton.

In order to assist in this work the Marketing Division maintains four air conditioned cotton research laboratories and in order to properly make up the official cotton standards the Division maintains four air conditioned cotton classing rooms.

Two of the laboratories are used for testing and measuring various physical properties of the cotton fibers under standard conditions. This work consists of taking individual cotton fibers from the sample to be tested and determining the length, the distribution according to length and weight, degree of immaturity, fineness, strength, thickness of the tubular walls, cross sectional diameter and shape.

This work is fatiguing, nerve racking and eye straining as the fibers are only from 1/25000 to 1/5000 inch in diameter, consist of 95% pure cellulose and are easily disturbed by slight air currents.

Therefore it is very important that air movement be kept at a minimum. It was specified that the air conditions were to be maintained with an air movement of not more than 6 ft. per minute.

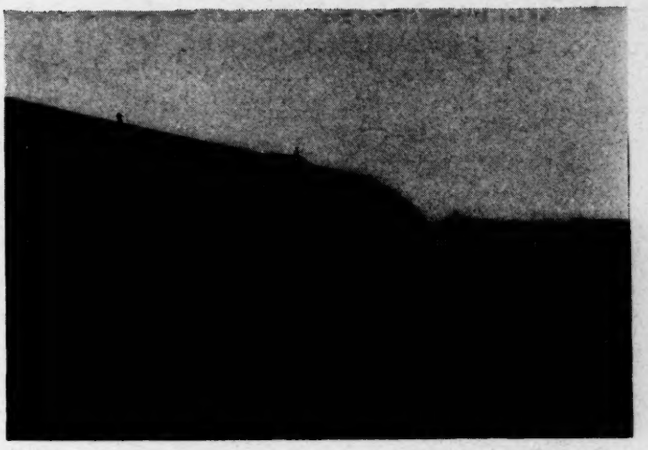
The actual conditions usually maintained in these two laboratories are 70F dry bulb and 55% relative humidity although the systems installed can maintain 70F with any relative humidity from 40 to 65%.

Two special research rooms have been installed to determine the effect of moisture and temperature on the properties of cotton. The first of these rooms which is known as the Moisture Laboratory has an air conditioning system which can maintain any temperature between 45F and 100F and any relative humidity between 40 per cent and 97 per cent. The second room which is known as the Special Research Laboratory has the system which will maintain any temperature from 32F to 100F and any relative humidity from 10 to 97 per cent. In both of these rooms since individual cotton fibers are to be tested the air motion is not over 6 feet per minute.

Cotton Classing Rooms

In the four cotton classing rooms various types of cotton are classified and the official cotton standard samples are made up. These samples are made up for grade, color and staple length, which takes cognizance chiefly of foreign matter like leaf and trash, and of degree of nappiness and neppiness as affecting general smoothness of the sample. In the preparation of the standards in this room it is desirable to maintain 70F and 65 per cent relative humidity. The system installed can provide any humidity from 40 to 65 per cent.

Interior of Cotton Fiber Laboratory showing ceiling and wall heat transfer coils, air inlet ducts, and glass brick insulated windows. Dehumidified or humidified air is brought in through ducts and discharged into the room downward through the coils.



Roof over Cotton Classing Rooms which is kept wet throughout the year with water from air conditioning systems on first and sixth floors. Water is distributed evenly by pipes, sprays and troughs.

The four cotton classing rooms are located on the top floor of the building and are provided with an even source of north light by large sloping skylights in the roof. Room 609 which is the main cotton classing room is approximately 77 ft. long, 60 ft. wide, and 11 ft. high neglecting the skylight space, while room 610, the cotton linters room, room 611, the staple length standards room, and room 612, another cotton classing room, together occupy a space which is 66 ft. long, 40 ft. wide, and 11 ft. high again neglecting the skylight space.

To maintain a 70F temperature in these rooms, heat transfer surface with water as the heating or cooling medium has been installed on the walls and ceilings. This heat transfer surface is mainly of the extended fin type although some of the original cast iron wall radiators which were installed when the building was erected also have water circulating through them.

All of the water used for cooling and heating of these rooms is provided by a deep well in the basement. About two-thirds of the water is supplied directly from the well while one-third is first used to cool or heat some of the laboratories on the first floor.

During the period when cooling is needed the water enters the coils on the sixth floor at a temperature of about 63F. Because of the large amounts of water and heat transfer surface which are employed together with the fact that roof overhead is kept wet and the windows are insulated with glass brick it is possible to maintain a 70F temperature under varying climatic conditions encountered at Washington.

During periods when less cooling is required the water volume is decreased. When the outside temperature falls low enough to require heating the water entering the surface is warmed by a steam heat ex-

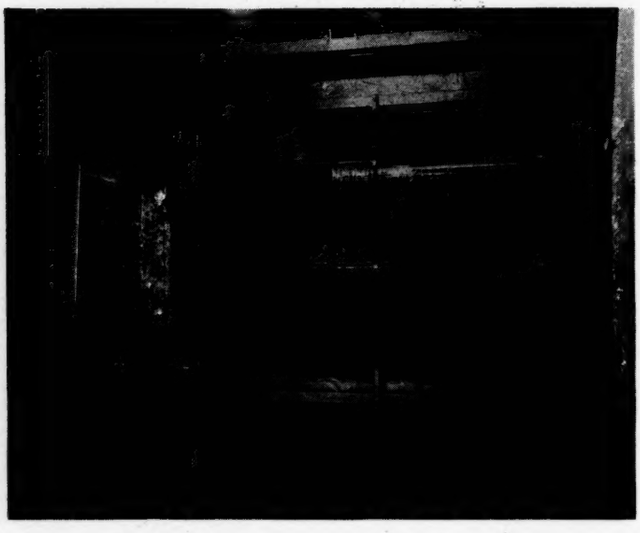
changer. The volume and temperature of the water are controlled by a room thermostat.

During both winter and summer the water leaving the heat transfer coils in the first and sixth rooms is allowed to flow over the roof and skylights before going to the sewer. This considerably reduces the cooling load during the summer and the heating load during the winter. It also helps to prevent condensation on the glass skylight during the winter.

The relative humidity of the room is maintained by bringing into these four rooms 1400 c.f.m. of air which has been humidified or dehumidified by a Calorider unit located in an adjacent room. The unit supplies air at 66F and whatever humidity is necessary to maintain the proper moisture conditions in the room.

The Calorider consists of a chloride brine spray chamber through which the air to be humidified or dehumidified is passed. The brine used will humidify the air when its vapor pressure is higher than the vapor pressure of the air and will dehumidify the air when its vapor pressure is lower. Thus by controlling the vapor pressure or concentration of brine it is possible to control the humidity of the outgoing air.

As set up in this installation, outside air is brought in through a duct, filtered and passed over a tempering coil to heat it to 80F. The air then passes over steam humidifying jets which are used only when the inlet air is below the desired humidity. From these jets the air passes to the brine spray chamber where it is washed, tempered to 66F and humidified or dehumidified depending upon the concentration of the brine. Cooling is accomplished by water coils in the spray chamber which takes up the latent heat as well as cools the air. The air then passes through eliminators which are designed to remove any small particles of the brine which may still be in the air and then enters the blower which forces it to the various rooms. The air is discharged into the rooms through wide nozzles back of the fin coils and must pass through this surface before it can enter the room.



Interior of Special Research Laboratory showing extended surface coils on walls and ceiling to produce any temperature between 32 and 100F. Humidity control equipment not shown will produce any relative humidity between 10 and 97 per cent. In corner is an instrument for measuring dewpoint when wet bulb is below freezing.

Panel board in laboratory supervisor's office. Left instrument controls, indicates and records temperature in Cotton Fiber Laboratory. Center instrument indicates and records twelve different dry and wet bulb temperatures in the Fiber, Special Research and Cotton Classing Laboratories. Right instrument controls, indicates and records directly the relative humidity in the Fiber Laboratory.

The concentration of the brine in the spray chamber is controlled by a concentrator. Brine is taken from the collecting tank beneath the sprays by a pump and part is allowed to flow to the sprays and part to the concentrator. The part which flows to the concentrator enters a heat transfer coil in the lower portion of the concentrator where it is warmed slightly by the hot brine which has already been concentrated. From these coils the brine flows to the top of the concentrator where it is sprayed over steam coils. The heat from the steam coils drives the moisture from the brine and the concentrated solution falls over the heat transfer surface in the bottom of the concentrator partially cooling the brine. The concentrated brine is then allowed to flow back to the Calorider unit.

Outside air is passed through the concentrator to pick up the moisture which has been driven from the brine by the steam coils. This moisture is then discharged out of doors.

The flow of steam to the heating coils and thus the concentration of the brine is controlled by a humidistat located in one of the conditioned rooms. Another humidistat located in the discharge from the Calorider unit overrides the humidistat controlling the flow of steam whenever there is an excessive demand for humidification. This is necessary to prevent crystals from forming in the chloride brine due to too high a concentration.

Both the humidity and temperature in these rooms are controlled from a panel board in an administrative office on the third floor. Also located on this panel board are recording instruments which indicate and make a permanent record of the humidity and temperature within the cotton classing rooms. These instruments are accurate to within 1/10 degree of temperature and 1/10 per cent relative humidity.

Fiber Testing Laboratory

The fiber testing laboratory and the cotton conditioning room are located on the first floor, one being 42 ft. long, 18 ft. wide and 10¼ ft. high, and the other 13 ft. long, 11 ft. wide, and 10¼ ft. high respectively.

In both of these rooms it is necessary to maintain a temperature of 70F year round and any relative humidity from 40 to 65 per cent within one degree and one percent plus or minus throughout the room with an air movement of not over 6 ft. per minute.

The unusual feature of the conditioning in these rooms is that while both rooms are supplied with air from the same Calorider unit it is frequently necessary to maintain separate moisture conditions in each of the rooms. This is done by having a humidistat in each room and by having them hooked up so that the humidistat calling for the lower humidity controls the concentration of the brine in the Calorider while the humidistat calling for the higher humidity controls the operation of a small humidifier in the inlet duct which then raises the moisture content to the proper level.

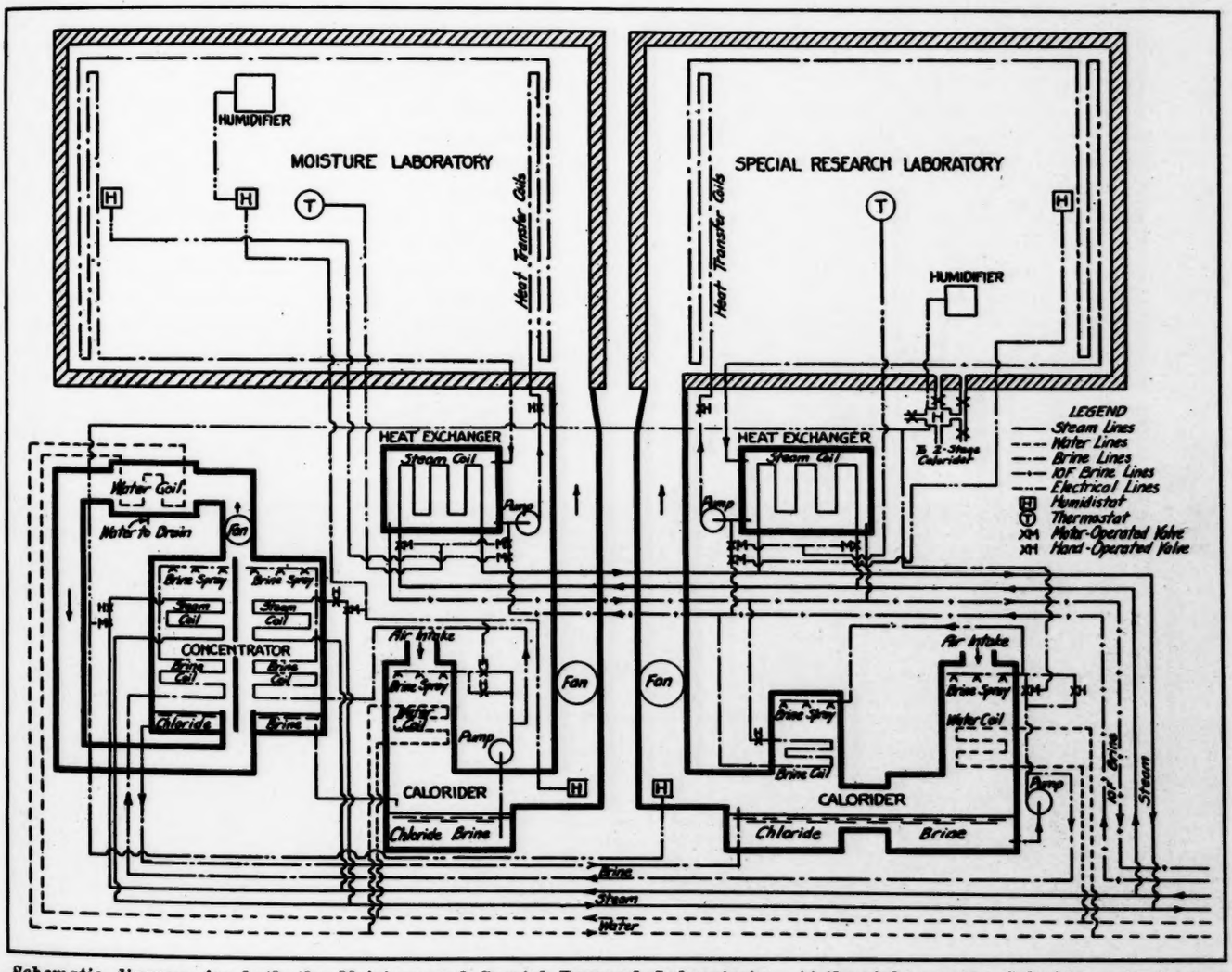
Another difference between this unit and the one in the cotton classing room is in the method of disposing of the moisture driven off from the humidity-controlling brine. In the unit on the sixth floor it was possible to get rid of the moisture simply by discharging the air through a duct to the roof. In the case of the unit on the first floor this was not desirable since it would have meant either discharging the air out through a window which would have streaked the side of the building or running a duct up to the roof.

The problem was solved by passing the moist air from the concentrator over cooling coils through which cold well water flows. The moisture is condensed out on these coils and is allowed to pass off to the sewer. The air is then recirculated to the concentrator.

Approximately 100 c.f.m. of air at 66F and the proper humidity is supplied by the Calorider unit to the Cotton Conditioning Laboratory while 400 c.f.m. at the same condition is supplied to the Fiber Testing Laboratory. As in the Cotton Classing Rooms all inlet air is discharged by wide nozzles in back of the extended fin surface and must pass through this surface before reaching the room.

This heat transfer surface is placed on the ceiling and walls. In this instance, however, instead of having one steam heating unit for heating the water to all rooms as was the case on the sixth floor, one heating unit is provided for each room. When the cooling system is operating during the summer the well water enters the cooling coils at 62F and leaves at 62½F picking up only ½F because of the large amount of water circulated. The flow and temperature of the water are controlled by a room thermostat.

An interesting feature of the equipment used for



Schematic diagram for both the Moisture and Special Research Laboratories. At the right are two Calorider units hooked up in series for supplying air at 10F and 10% relative humidity to the Special Research Laboratory. In the center is the Calorider unit for supplying air at 66F and 10% to the Moisture Laboratory. At the left is a double concentrator for concentrating the brine from the Calorider units. Two heat exchanger tanks which supply cooling and heating brine are shown above the Calorider units. See next page for picture of this equipment.

conditioning these two rooms is the small space occupied. All of the equipment is housed in a room 12 ft. long, 7 ft. wide, and 10 ft. high.

Both the temperature and humidity in the Fiber Testing Laboratory are regulated from the supervisor's office on the first floor. In this office is a panel board on which are mounted three indicating and recording instruments; one for showing the dry bulb temperature and one the relative humidity in the Fiber Testing Laboratory while the third records the dry bulb temperature in each of the eight laboratories and out of doors as well as the wet bulb temperature in the main cotton classing room, the pre-conditioning laboratory and the out of doors.

Special Research Laboratories

In the two special research laboratories located on the first floor the extremely accurate temperature and humidities must be provided. The first of these two rooms, the Moisture Laboratory, is 16 ft. long and 12 ft. high. It has its air temperature maintained by brine which is circulated through coils buried in the floor and mounted on all walls and ceiling. The temperature at which the brine is circulated depends upon the room temperature desired and is only one degree below the air temperature in the room. This low temperature differential is used to prevent unnecessary air currents as the air movement is limited to 6 ft. per min.

The brine which is circulated through the coils is obtained from a brine tank on the first floor. It is possible to obtain any temperature brine from 10 to 100F from this tank as it is supplied with 10F brine from a basement brine tank and also has a steam heating coil in it so that higher temperatures may be obtained.

A room thermostat controls the flow of brine and steam to the brine tank and gradually closes the valve in the 10F brine line as higher temperatures are required and then gradually opens the steam valve.

A humidistat set on the coils in the room prevents the formation of moisture on the coils by shutting off the cold brine if the humidity near the coil surface approaches the saturation point. This acts as a safety device if for any reason the humidity control equipment does not operate.

The moisture control equipment used for this room is much the same as for the other rooms except that a different chloride brine is used and the air is brought into the room at 66F and 10 percent relative humidity. Approximately 100 c.f.m. is supplied. Another point of difference is that a steam humidifier located directly in the room is used to provide the very high humidities.

The second room which is called the Special Research Laboratory is of the same size as the first, has the same method of temperature control, and is supplied with the same amount of air.

The moisture control equipment consists of two Calorider Units hooked up in series with the latent cooling coils in the first unit supplied with well water and the latent cooling coils in the second unit supplied with 10F brine. All these Calorider units, the two for the Special Research Laboratory and the one for the Moisture Laboratory, have one common concentrator.

The temperature and humidity in both of these special laboratories are controlled from a common panel board outside of the laboratories. This panel has a temperature and direct relative humidity indicator, recorder and controller for each laboratory.

Located in the basement is a refrigerating room which supplied the 10F brine to the two special laboratories. In this room are two four-ton ammonia condensing units one of which is used to cool the brine. The other unit is kept in reserve to insure a continuous supply of cold brine every day of the year.

The brine is cooled by direct expansion coils and is stored in a tank. A brine pump circulates the brine to both brine tanks on the first floor.

Water is supplied for both cooling and heating by a 175 g.p.m. deep well pump located in the basement. The water has a temperature of about 60F during the summer and 62F during the winter. The greater portion of the water is used for heating and cooling the laboratories although some is used in the concentrators and during the summer some is used by the refrigerating condensing unit when the city water temperature rises above 61F.

(Left) Air conditioning equipment for Moisture Laboratory. At the left is the Concentrator for the Calorider units for this and the Special Research Laboratory. In the center is Calorider unit which supplies 100 c.f.m. of air at 66F and 10 per cent relative humidity to Moisture Laboratory. (Right) Air conditioning equipment for Special Research Laboratory. At lower left and center are two Calorider units hooked in series which supply 100 c.f.m. of air at 20F and 10 per cent relative humidity to Research Laboratory. At right are two well insulated brine tanks which furnish the brine at any temperature from 10F to 100F for heating and cooling the Special Research Laboratory.

Summer Comfort Cooling Requirements for the Southwest

By A. J. RUMMEL†

Decision as to where to fix the desired indoor conditions is of importance in calculations for the heating and cooling load. The author believes that the decision should be based on the special considerations of the job at hand rather than merely depending on averages. The condition to be aimed at generally in comfort cooling is suggested as 73F effective temperature, without change as the outside weather changes. For winter he feels that the effective temperature indoors should be placed at 67 to 70 F. Air movement should be slight but should be steadily maintained, the author told the Third Annual Conference on Air Conditioning held at the University of Texas.

REALIZING that no phase of engineering today presents so many diverse opinions as the question of what constitutes comfort, and taking cognizance of the fact that the most agreeable sensation of comfort is where the occupant is completely oblivious of any feeling of discomfort, the air conditioning industry has already spent over ten million dollars in an effort to determine what makes people comfortable and the atmospheric conditions that in most cases will produce these sensations of comfort.

So far it has been found that all people, regardless of whether they are from the frozen north or from the tropics, seem to have the same primitive trait of desiring a temperature for comfort of somewhere between 60F and 80F. Although it is granted that people who live in warm climates become acclimated and can apparently stand somewhat higher temperatures without suffering ill effects, they are not necessarily comfortable while doing so. It has also been determined that regardless of the mildness or severity of the seasons there is very little difference in the optimum effective temperature desired by occupants who remain in a conditioned space for an hour or more. It was formerly believed that in those localities where the average yearly temperature was rather high the optimum indoor conditions for comfort would be higher than the optimum indoor conditions desired by people who lived in the cooler climates. However, recent studies indicate such a belief to be erroneous. It was found that in Texas an optimum effective temperature of approximately 73F was desirable for any large group of persons of both sexes, and about 2F lower was indicated as desirable for a location as far north as Canada. Since other tests also show that a plus or minus 1F of effective temperature from the optimum is not a very important factor in a person's feeling of comfort, it is evident that an optimum temperature in the neighborhood of 72F would be satisfactory in almost all localities.

Although much has been done to establish the indoor atmospheric conditions most conducive to health and comfort, any discussion of design standards can be based only on present day knowledge. It is becoming more and more evident that some of our present day thoughts concerning those factors affecting comfort will be materially changed and that in the future a more definite index of comfort will be established than the present day effective temperature index. In the light of recent investigations of the comfort of individuals, it is becoming increasingly evident that two of the most important factors—and those on which a very limited amount of practical data is available in connection with our standardized comfort charts of today—are air motion and radiation. A recent report stated that in the zone of body cooling:

(1) The dissipation of heat from the body was little influenced by relative humidity.

(2) Heat losses of the body were influenced chiefly by air and wall temperatures.

(3) Air movement greatly affected the body heat losses.

When we consider that the human body forms only a small part of the total load of most air conditioning installations, it appears rather evident that present methods of controlling this body heat loss by warming or cooling great masses of air and building materials is inefficient. In effective temperatures within the limits of the comfort zone people at rest dissipate a considerable part of their total body heat by radiation. If practical and efficient means of allowing the body to dissipate this amount of radiant heat more directly could be used it would be possible to greatly reduce the air temperature differential between indoors and outdoors, thereby reducing the total load considerably. For instance, laboratory experiments have shown that in winter if in a room having an air temperature of 70F the wall temperatures were kept at 55F the cooling effect would be about 4F. Other tests have shown that in a room maintaining a temperature of from 89 to 92F and a relative humidity of from 60% to 70% adequate body cooling took place when cold plates maintained at temperatures of from 32 to 40F were installed in the walls of the room.

Some engineers seem to be of the opinion that satisfactory comfort conditions will result as long as air movements in the conditioned space are maintained anywhere from 0 to 25 f.p.m. Actual observations of the reactions of over 150 office employes over a two-

†Air Conditioning Engineer, San Antonio Public Service Co., San Antonio, Tex.

year period have indicated that this might be true if the air movement is maintained constant and the same at all points in the conditioned space. It has also been noted that for the same temperature conditions, a condition of still air will produce a feeling of warmth while an air movement in excess of 20 f.p.m. will be objectionable. Since it is necessary to have some air movement to eliminate the occupants' psychological reaction of air staleness, the main factor to be guarded against is a change in velocity as this is what causes the change in the feeling of comfort.

Due to the difficulty we have with most of our present day installed systems in maintaining constant air movements within the conditioned space, with changing air quantities supplied to satisfy temperature conditions, it appears that the split system of air distribution offers the best solution. With this type system, approximately the same quantity of air is supplied regardless of the temperature requirements, thereby allowing for a practically constant air movement at all times. The two air supplies of the split system are regulated by a motor-operated double damper, actuated by a thermostat. One supply furnishes outside and recirculated air while the other supplies conditioned air. As the temperature condition within the conditioned space is satisfied the damper in the duct supplying the conditioned air closes while the damper in the outside and recirculated air duct opens, thereby maintaining the same quantity of air supplied to the conditioned space but at a higher discharge temperature.

Considering the standards accepted today, we also find that the methods used in computing our loads are of such a nebulous nature that it is almost impossible to arrive at any standardized factor, and the factors used in the layout of any installation are left more or less up to the best judgment of the engineer in applying same. Much work is being done in investigating the effect of solar radiation. The solar radiation data available at the present time cannot be used accurately due to lack of widespread data on the intensity of the sun's rays, the effect of water vapor and dust particles in the atmosphere, and the angle between the sun's rays and the surface it strikes.

In addition to an apparent lack of conclusive information on design factors, in most cases the information we do have is not used correctly or, I should say, not enough thought is given to the limitations of the data we have. We often see air conditioning specifications prepared in which general laboratory comfort standards are made the basis of a contract; whereas the general type of occupancy and traffic in the particular installation being planned is such that these general standards will not apply.

It is almost impossible to designate any certain set of temperatures and humidities for comfort unless a very careful and thorough analysis is made of all conditions which might affect the comfort of the individual to be made comfortable. For instance, in investigations carried on in Texas during the summer of 1938 it was found that the same percentage of people (92%) entering an air conditioned building from the outside were comfortable when the building was maintained at 72F effective temperature as were those entering buildings maintaining 76F effective temperature; whereas for those people who remained inside these buildings it was found that in the higher effective temperature of 76F only 25% were comfortable after having been in the building an hour or longer, as compared to no change in the percentage when the effective temperature was 72F.

In planning a commercial installation, many factors must be considered before specifying the conditions to be maintained indoors. Is the installation being made for the comfort of the employes or for the transients; the average length of stay; mostly men or women; activity, etc. One of the most important factors to be considered is the shock reactions of the people entering the conditioned space. The importance of considering the shock, especially from the standpoint of the transient public, is quite evident when it is considered that most people who enter an air conditioned building have been more or less active prior to entering and in most cases their bodies are wet due to perspiration. The person outdoors in 95F dry bulb temperature dissipates almost 85% of his total body heat as latent heat and only 15% as sensible heat. In going from outdoors into a conditioned space which is maintained at 78F the sensible heat loss increases from 15% to 70%; but since the body is wet, the latent heat loss is not reduced immediately, with the result that the total heat loss from the body is increased about 50% above the normal loss, which naturally gives a cold shock. On leaving a conditioned building a hot feeling is experienced due to lag in the perspiration starting, thereby not allowing the body to lose its heat until equilibrium has been reached. The duration of the cold shock upon entering a conditioned building has been found to be approximately ten or fifteen minutes for effective temperatures of 71.5F or higher; whereas the length of the cold shock is greatly extended when the temperature is below this figure.

The following factors which are the result of investigations that have been made to establish indoor atmospheric design standards for comfort cooling should be given consideration in the design and operation of any air conditioning system in the southwest:

(1) The optimum effective temperature for persons who remain in a conditioned space for a period of one hour or longer seems to be about 73F effective temperature (45 to 60% relative humidity) for all age groups and for both sexes.

(2) For all persons over forty years of age, both men and women, the optimum effective temperature is approximately one-half degree higher than for those under forty years of age.

(3) The optimum effective temperature for women of all age groups is about 2F higher than that for men of all age groups.

(4) Wearing a coat makes one comfortable at from 1 to 2F lower effective temperature.

(5) Very little shock is noticeable upon people entering a building with an effective temperature of 71.5F or higher.

(6) The indoor optimum effective temperature does not seem to vary with the normal outside variation in temperatures during the summer months.

In year-round tests conducted it was found that the

indoor optimum effective temperature varied only about 5F degrees, although the outdoor dry bulb temperature varied as much as 60F from time to time.

(7) People whose health might be classed as not perfect desire a temperature about 1F higher than those in perfect health.

(8) People are more tolerant of a slight feeling of warmth than of a feeling of being too cool.

(9) Tests conducted with college students at Texas A. and M. College indicate that the optimum indoor condition during the winter is about 67F effective or 1F higher than the comfort chart as adopted by the ASHVE.

Although no detailed tests have been made it is indicated from the reactions of employes of all ages and sex doing routine office work that an indoor effective temperature of between 69F and 70F effective is most desirable.

House Radiator Sizes

THE most frequently found radiator size in houses in the New York area is between 17½ sq. ft. and 27½ sq. ft., according to a survey of 128 new homes of modern construction built in the metropolitan area within the past two years. The survey and analysis was made by J. W. Knoblock, president, Cond-Atmos Corporation, New York, through whose courtesy the accompanying data are presented. The survey did not include a study of the radiator sizes required in kitchens, lavatories, or bathrooms.

In the survey the heat loss was calculated for each of the rooms and the radiator size was determined from the heat loss calculation rather than from the actual radiator installed in the room.

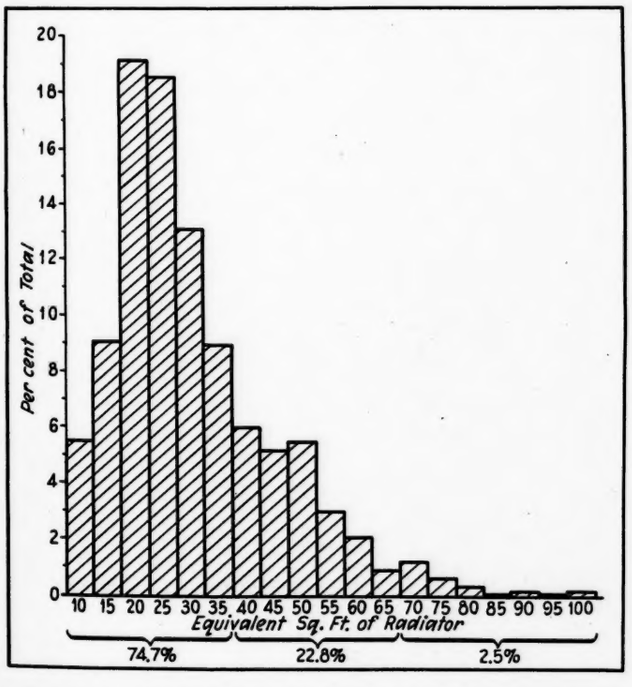
The 128 houses surveyed had a total of 900 rooms coming within the scope of the study. These houses covered a wide range of size, as shown in Table 1.

The number of radiators found in the 900 rooms surveyed have been tabulated in Table 2 according to type of room. This table shows, for example, that of the 125 living rooms, 2 had 20 sq. ft. of radiator; 5 had 25 sq. ft. of radiator, etc., and that 50 rooms of all types had 10 sq. ft. of radiator; 82 rooms had 15 sq. ft. of radiator, etc. The totals are expressed in percentages in the last column; these are also plotted in the bar chart in Fig. 1.

As shown in Fig. 1, 74.7% of all the rooms surveyed required radiator sizes ranging up to 37½ sq. ft. The most frequent size, as shown in Fig. 1, was the 20 sq. ft. (which included those between 17½ and 22½ sq. ft.), found in 19.3% of all rooms.

TABLE 1. NUMBER OF HOUSES IN SURVEY GROUPED ACCORDING TO HEAT LOSS

No. of Houses	Heat Loss in B.t.u. per Hr.
1	43,000
15	50,000 to 69,000
25	70,000 to 89,000
22	91,000 to 99,000
27	100,000 to 119,000
21	120,000 to 149,000
12	150,000 to 189,000
5	199,000 to 220,000



Frequency distribution of radiator sizes in all rooms of New York houses as determined by a survey.

TABLE 2. RADIATOR SIZES FOR DIFFERENT ROOMS
(From a survey of 900 rooms in 128 houses; baths and kitchens not included)

Equiv. Sq. Ft. Rad.	Living Room	Hall	Dining Room	Bed Room	Den	Total	Total, Per Cent
	Number of Rooms						
10	—	17	—	5	28	50	5.5
15	—	30	2	30	20	82	9.1
20	2	35	22	94	20	173	19.3
25	5	14	32	109	8	168	18.7
30	4	11	22	76	5	118	13.2
35	16	7	11	44	3	81	9.0
40	9	3	11	27	4	54	6.0
45	15	1	10	18	3	47	5.2
50	19	4	10	17	—	50	5.5
55	20	—	—	7	—	27	3.0
60	10	1	2	6	—	19	2.1
65	7	—	—	1	—	8	0.9
70	9	—	—	2	—	11	1.2
75	3	1	—	1	1	6	0.7
80	3	—	—	—	—	3	0.3
85	—	—	—	—	—	—	—
90	1	—	—	—	—	1	0.1
95	—	—	—	—	—	—	—
100	2	—	—	—	—	2	0.2
Total	125	124	122	437	92	900	100.0

Adequate Ventilation is Found Necessary for Factory Degreasing Rooms*

By W. B. HARRIS†, C. B. FORD†, F. A. PATTY‡, and THEODORE HATCH†

OIL and grease films which form on the surface of metal objects during their manufacture must be removed before the parts can be successfully plated, enameled or painted. Several methods of degreasing have been developed including washing in a suitable oil and grease solvent. This method is widely used at the present time, particularly for the degreasing of small metal parts and the solvent commonly employed is trichlorethylene, a chlorinated hydrocarbon.

Although trichlorethylene is non-inflammable, at high temperatures such as occur in gas flames, electric heaters and burning tobacco, its vapors may decompose with the formation of corrosive and toxic substances such as hydrochloric acid and phosgene. To prevent inhalation of these, the combustion products from open flames must, therefore, be vented so as to be disseminated safely outside of the building, and smoking in the vicinity of equipment using trichlorethylene must be prohibited.

In the operation of a trichlorethylene degreasing tank, the solvent is heated to the boiling point with the consequent generation of concentrated vapor in the tank over the boiling liquid. The parts to be cleaned are dipped into the liquid and then suspended in the vapor zone for rinsing before withdrawing from the tank. A condenser built into the tank walls cools the vapor, causing it to condense and return to the liquid supply, thus utilizing the solvent over and over. A well adjusted balance between heat input, cooling capacity, rate of input of metal and cleanliness of the solvent is required in order to insure the continuous operation of the cycle without escape of excessive quantities of the vapor from the tank.

The constant generation of vapor, however, establishes a potential health hazard which becomes real when the operating balance between the liquid and the vapor is not constantly maintained. Because the loss of trichlorethylene vapor from the tank represents an increase in separating cost, the matter of proper operation assumes economic as well as hygienic importance and is thus more likely to be watched. However, degreasing equipment of this type is widely used in small manufacturing plants where quarters may be limited and supervision and maintenance poor and the potential hazard associated with the use of trichlorethylene in such establishments is therefore greater than that existing in large plants. Hence, it is important to inquire into the requirements for proper design and safe location and operation of degreasing tanks and to determine the need for and design of ventilating systems for such equipment.

The present report deals with such an inquiry involving the survey of 50 plants in metropolitan New York with the detailed study of 15 of these. The plants were selected at random to give a good sample of conditions and include 26 of one manufacture, 20 of another and four of homemade construction. In size the tanks varied from 140 square inches to 15 square feet and were located in rooms varying from 2000 to 375,000 cu. ft. in volume.

Our survey revealed that for the most part the degreasing tanks were located in large rooms, only 10 being found in rooms less than 10,000 cu. ft. in volume. In the detailed study of the 15 plants the beneficial effect of natural dilution of the vapor was observed in all cases where the room volume was 20,000 cu. ft. or more and no disturbing drafts were present. Thus, in four different rooms varying from 30,000 to 160,000 cu. ft. in volume and provided with general ventilation at the rate of 5—12 air changes per hr. the concentration of trichlorethylene vapor was zero in the general room air while in the breathing zone of the operator the maximum concentration did not exceed 150 p.p.m. The solvent losses reported for the four tanks were 1.0, 3.9, 4.5 and 5.3 gallons per square foot per 100 hours operation, respectively.

In contrast to the results reported above, the vapor concentration in smaller rooms was found to be high, even in the general air, except when adequate ventilation was provided. The data presented in Table 1 indicate that all tanks located in confined spaces should be safeguarded by means of general ventilation at a rate of 30 air changes per hr. It is to be observed, however, that general ventilation alone is not enough to control the exposure directly at the breathing level of the operator and local exhaust ventilation may be required in addition. When used in conjunction with local exhaust ventilation the rate of general ventilation can probably be reduced below 30 air changes per hr.

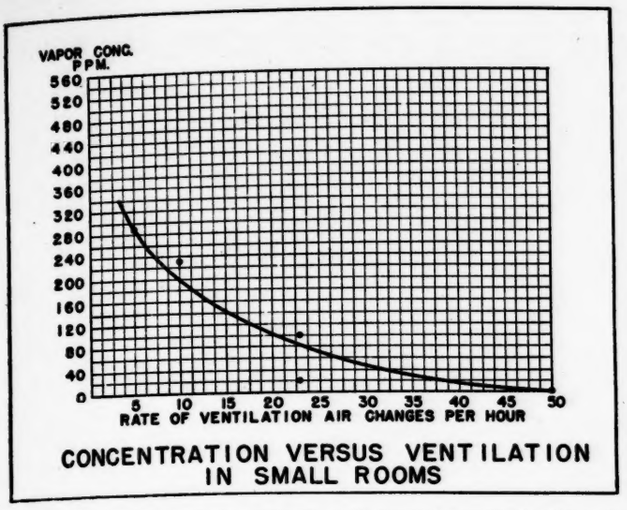
TABLE 1. VAPOR CONCENTRATION AND VENTILATION RATE IN SMALL ROOMS

Plant No.	Room Volume, Cu. Ft.	Air Changes per Hour	Vapor Concentration, P.P.M.	
			Breathing Zone	General Room Air
6 B	2500	5	500	290
15 D	6000	10	290	230
10 D	4000	23	500	100
13 D	2000	Natural, strong	340	80
13 D	3000	23	400	20
19 D	3000	50	60	0

*Abstracted from a paper presented at the annual meeting of the American Public Health Association, 1938.

†Division of Industrial Hygiene, State of New York, Department of Labor.

‡Chief Chemist, Fidelity and Casualty Co., New York.



Relation between air changes and vapor concentration in degreasing rooms.

The tank location must also be selected to avoid disturbing drafts created by open windows and doors, fans, etc., since the action of such drafts is to drag vapor out of the tank and disperse it in the room. In this connection, the location of the tank must be carefully considered in relation to paint spray booths which are commonly operated in conjunction with degreasing equipment. Spray booths require high rates of ventilation and strong air currents are thus established in the immediate neighborhood. In one plant the opening of the doors was found to create a strong draft by the tank which was corrected by erecting an entrance vestibule. Drafts may be created by the general ventilating system. To prevent this, air inlets should be located near the ceiling, remote from the tank, and provided with upward deflectors, while outlets should be placed near the floor since the heavy vapor tends to gather at low points.

A gas-heated degreasing tank with natural draft ventilation of the combustion chamber should not be located in a room in which a mechanical exhaust system is installed unless ample free opening is provided for the intake of make-up air for the exhaust system. Otherwise a negative pressure would develop in the room which might cause a reversal in the direction of air flow through the natural draft vent pipe and thus bring the flue gases into the room. These gases may include not only the toxic products of gas combustion but also phosgene resulting from the pyrolysis of trichlorethylene. The escape of trichlorethylene vapor into a room in which welding and similar high-temperature operations are going on also presents a potential phosgene hazard and must be avoided.

The exhaust ventilation should be applied laterally at the edges of the tank since the heavy vapor tends to roll over the edge and fall to the floor. A ventilating rate of 60 c.f.m. per foot of tank perimeter has been found to be adequate. This produces an air movement of approximately 20 f.p.m. toward the exhaust openings at a distance of one foot from the slot. The application of ventilation to the tank disturbs the vapor zone in the tank somewhat and increases the solvent loss. This loss obviously increases with slot velocity. Moreover, it is known that the efficiency of control by lateral ventilation at a given total rate of air flow decreases with an increase in slot velocity. Hence, it is desirable to keep this velocity at a low figure. At the same time, the slot velocity must be high enough to make the entrance loss substantially greater than the internal loss in the section of duct into which the slot opens so as to provide for uniform air flow over the tank area and into the exhaust system. An entrance velocity of 500 f.p.m. appears to be the minimum practical value.

Conclusions

So far as exhaust ventilation is concerned, it is concluded that:

A—All degreasing tanks in confined rooms (less than 20,000 cu. ft.) and other installations not favorably located or properly operated must be provided with local exhaust ventilation. General ventilation is not recommended in place of local exhaust ventilation but may be required in addition.

B—Exhaust ventilation should be by lateral movement into slots along the edge of the tank with a ventilating rate of 60 c.f.m. per foot of tank perimeter. The slot velocity should be approximately 500 ft. per min. and provide for uniform ventilation over the entire tank area.

C—Provide a ventilated booth or table where necessary for the temporary holding of cleaned parts for drying or for cooling.

Temporary Stoves Used to Heat Westminster Hall

WESTMINSTER HALL, described as the heart of the British Empire, is rather a cold place to bear a distinction of that kind. It has no heating system, like so many ancient buildings, and evidently it is considered that hot water pipes, a hot air system, or electric radiators would impair the stern beauty of the ancient hall. According to the *Heating and Ventilating Engineer*, London, a novel idea has to be resorted to for ceremonial occasions, such as the recent reception for President Lebrun. In order that the air would not be chilly, two huge stoves were installed, but they were removed before the reception took place.

The idea was ingenious, though rather elaborate. Workmen erected around the front entrance to Westminster Hall in Palace Yard a screen that enclosed the porch. This was part of a scheme to seal the interior of the hall from the outside air. All windows were closed and outlets stopped. Then, for three weeks before the visit, the fires in the stoves were kept going until every ancient stone was stored with heat.

On the very eve of the visit the stoves were taken away and the screens removed, leaving the hall in its original state. It was found that enough heat was put into the stones to last until the reception was over.

The Flow of Air and Its Distribution Through Ducts

Part 5—Solution of Duct Layout Problem

By J. R. ZWICKL†

IN order to illustrate the application of the theory outlined in the preceding article of this series, let us now consider and solve an example.

Example: In an air heating system 20,000 c.f.m. of standard air enters the intake side of the heater at A, Fig. 5, is heated to 160F, whereby its volume increases to 23,400 c.f.m. Then it enters the fan and is discharged into a duct system as shown in Fig. 5. Air is to be discharged at four points into side branches, the volumes and distances of these points being shown in Fig. 5.

Solution: Knowing the volumes delivered into each side branch, the volume flowing through each next section of the main branch is found by subtraction; these volumes can be expressed in percentages and the proper values entered in the first four columns of Table 8.

Reference to Table 4 (Part 2 of this series) gives the values of d_x and j_x corresponding to the given values of q_x and these values are entered in columns 5 and 7 of Table 8.

We shall assume $d_1 = 45$ in. $= 3.75$ ft. for the first section of the duct. This gives an area $A_1 = 11.05$ sq. ft. and a velocity $v_1 = \frac{23{,}400}{11.05} = 2120$ *f.p.m.* As this velocity is not excessive for the case in question, we shall keep $d_1 = 45$ *in.* (if this v_1 were too high, a larger d_1 is to be taken; or we select a proper value for v_1 and figure d_1).

Knowing d_1 as 45 in. we enter 45 in the first line of column 6 of Table 8. The values of d_x for the succeeding duct sections are found by multiplying this 45 in. by the value of d_x in per cent taken from column 5:

$$d_x \text{ (in inches)} = 45\left(\frac{d_x\%}{100}\right).$$

This fixes the duct dimensions in terms of "equivalent diameters."

Having fixed the main duct diameter as $d_1 = 45$ *in.* and $v_1 = 2120$ *f.p.m.* we find the main duct velocity head $h_o = \left(\frac{v_1}{4000}\right)^2 = 0.282$ *in.*

The total length (l) of the main branch is (26 + 32 + 60 + 40 + 60) = 218 ft.

With the main diameter d_1 and the velocity v_1 fixed we can figure the line loss $(h'_1)_o$ via equation (34) or we can find the hundred feet loss h'_{oo} from a friction chart and then find $(h'_1)_o = (h'_{oo})\, l/100$. For this case we find the hundred foot loss: $(h'_{oo}) = 0.124$ *in.* and the line loss: $(h'_1)_o = 2.18 \times 0.124$ *in.* $= 0.270$ *in.* of water.

We have four 90° elbows in our main branch; the elbow loss coefficients (e_x) are 0.2 and 0.1, respectively, as marked on Fig. 5 for each elbow. With these e_x values and the corresponding j_x values (for the same section) we can figure the elbow losses via equation (37). We find:

$$\Sigma j_x e_x = (0.768 \times 0.2) + (0.496 \times 0.1) + [2(0.349 \times 0.1)] = 0.273$$

and with that the sum of all elbow losses will be

$$h'_L = 0.273 \times 0.282 = 0.077 \text{ in.}$$

The static regain we can figure via equation (36) by assuming a value for r according to the quality of the work. With $r = 0.5$ we find:

$$h_r = 0.5 \times 0.282\,(1 - 0.349) = 0.092$$

Assuming the last supply grille at the end of our main branch (end of section 5) requires a static head of $h_g = 0.080$ *in.* we find for the apparent resistance of our main branch (as per equation 38):

$$(H')_o = (0.270 - 0.092) + 0.077 + 0.080 = 0.335 \text{ in. of water}$$

The true system resistance is found as per equation (38c):

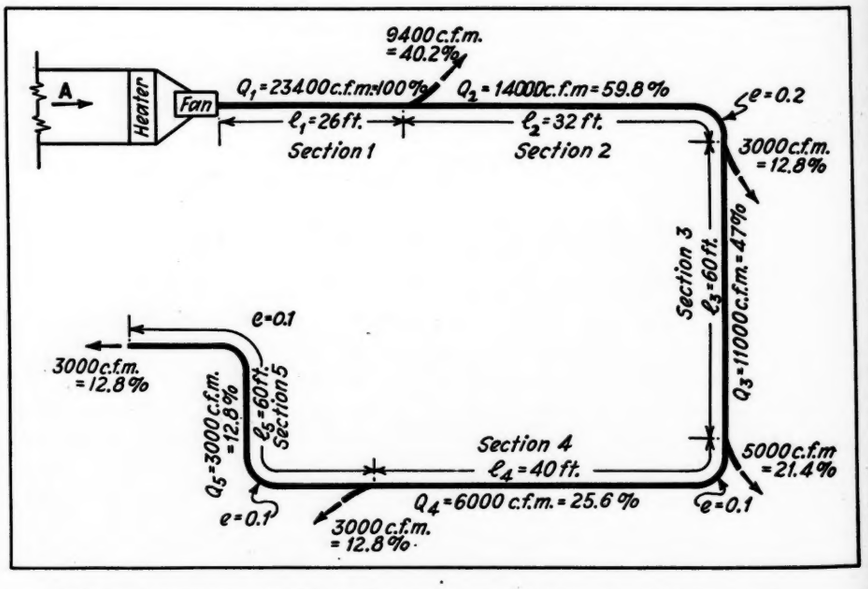


Fig. 5. Layout of simple duct system, calculations for which are given in this article.

†Worthington Pump & Machinery Corp., Carbondale Div., Harrison, N. J.

TABLE 8. TABULATION OF DATA FOR TYPICAL EXAMPLE

Section		Volume		Diameter, d_x		Velocity-Head Ratio, j_x	Values of k_x	Aspect Ratio b_x	Rectang. Duct Dimensions, Inches		
No.	Length, Ft.	Q_x, C.F.M.	q_x, %	%	Inches				Depth H	Width B_x	Final Width, B_x
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12
1	26	23,400	100.0	100.0	45.0	1.000	1.875	3.180	24	76.3	76½
2	32	14,000	59.8	82.6	37.2	.768	1.550	2.075	24	49.8	50
3	60	11,000	47.0	75.6	34.0	.679	1.415	1.700	24	40.5	40½
4	40	6,000	25.6	60.3	27.1	.496	1.130	1.070	24	25.7	25¾
5	60	3,000	12.8	46.6	21.0	.349	0.875	0.648	24	15.5	15½

$$H' = (H')_0 \frac{530}{620} = 0.286 \text{ in.}$$

For selecting the fan, we need the fan table static $(h_s)_0$. Since in this example the temperature in the fan is the same as that in the duct

$$(h_s)_0 = (H')_0 = 0.335$$

as the nominal static for the delivery side of the fan. (See equation 43a).

Having fixed the main diameter d_1 as 45 in., and correspondingly all the d_x diameters for the succeeding duct sections, we can proceed with their replacement by equivalent rectangular ducts. We know from equation (27) that $d/H = k$ and also that $k = f(b)$.

We can select at will one of the two dimensions so as to conform with the construction of the building. Usually we select the height of the duct: H_x. (Quite naturally H_x can have a different value for each section.) With the selected H_x we figure the k_x value for the section as $k_x = \left(\frac{d_x}{H_x}\right)$ and enter this value in column 8. (For this case we selected $H = 24$ *in.* for all sections and column 8 gives the corresponding k_x values). Then to each k_x value we find from Table 3 or Fig. 1 (in Part 2) its corresponding b_x value, which we enter in column 9. Finally with the b_x values we find the width of duct as $B_x = b_x H_x$, which we enter in column 11. These B_x values we may round out to the nearest ½ or ¼ in., so as to make the manufacture of the duct easier.

This decides the delivery side of our fan.

If there is a duct system also on the intake side of the fan, we figure its resistance in exactly the same way from the fan backwards and figure from it the nominal static for the intake side. Quite naturally this appears as a negative pressure, i.e., suction at the fan inlet.

The total nominal static, which the fan must produce to maintain the assumed flow is the difference of these two nominal static heads (i.e. the sum of their absolute values). This known, we select from the fan tables a fan which will deliver our $Q_t = 23{,}400$ *c.f.m.* (and not Q_0) with the above total nominal static.

The old way of figuring duct resistance was to express the duct length as a multiple of the main duct diameter and take one velocity head loss for every C ft. length (see equation 9). With $C = 50$ we would get as our line loss 0.327 in. which is about 21% greater than the correct value of $(h'_1)_0 = 0.270$ *in.* as figured above. For larger diameters and velocities the discrepancy is even greater.

The author will conclude his series on air flow next month with an installment on Fan Laws and Fan Selection.

High Efficiency Wood Stove Being Developed by Vermont University

A new type of stove which would employ the principle of slow combustion, whereby the wood is distilled into gas and led into a combustion chamber to be burned, is being developed at Norwich University, Northfield, Vt. Stoves based on this principle are now in use in Germany, Sweden and Switzerland, according to Professor D. E. Howes of Norwich University, but their design does not fit the needs of American households. Professor Howes said that their efficiency of combustion ranged from 75 to 90% against 55% and lower in the ordinary stoves.

Stoves and furnaces using the slow combustion principle have another decided advantage. They need to be stoked only once or twice daily instead of the constant feeding common to the type now in use. Progress made thus far indicates that the new heating apparatus will be as great an improvement over those now in use as the latter were over the Franklin stove and fireplace.

Because the wood to be burned in the new type of stove probably would need to go through a process of manufacture, increased industrial activity and possible solution of the current problem of conservation and use of waste wood are other favorable features likely to result, is the belief of Norwich professors.

ABSTRACTS of Current Papers, Books and Pamphlets

Piping Handbook

During the past seven years many changes have taken place in the piping practice. Welded joints have come into their own; readymade welding fittings have been invented and have gone into quantity production and use; welding-end valves have been developed and adopted; superheated-steam temperatures have advanced from 750 to 950F; new methods of pipe manufacture have been introduced; more dimensional standards and materials specifications have been formulated; and many other changes have taken place. In order to make the Piping Handbook fit these advances the authors have thoroughly revised and enlarged it in this the third edition.

Important changes and additions have been made in the sections dealing with metallurgy of piping materials; pipe, valves and fittings; heat insulation; steam power-plant piping; and oil piping. The rational-flow-formula method of dealing with pressure drops on the English-unit-system basis equivalent of Reynolds numbers, featured in the first and second editions, has been augmented by the inclusion of recently available data on the viscosity of steam and various gases.

A list of the chapter headings follows: Definitions, Formulas and Tables; Fluids—Properties of Fluids; Metallurgy of Piping Materials; Pipe, Valves, and Fittings; Heat Insulation; Hangers and Supports; Expansion and Flexibility; Steam Power-Plant Piping; Building Heating Systems; Plumbing Systems; Underground Steam Piping; Water-Supply Piping; Fire-Protection Piping; and Oil Piping.

[*"Piping Handbook," by J. H. Walker and Sabin Crocker. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York. Cloth-bound; 4½ x 7¼ in.; 897 pages; price, $6.*]

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Fractional Horsepower Electric Motors

Primarily this book was written to serve the needs and interests of practical men engaged in the installation, maintenance and repair of fractional horsepower motors. A fractional horsepower motor has been defined by NEMA as a motor built on a frame smaller than that having a continuous rating of 1 hp. open type at 1700 to 1800 r.p.m.

The aim of the book is to tell the story of fractional horsepower motors, what types and kinds are available, what makes them run, what they will do, and how to repair them. The book has been written so that it may be read either consecutively from the first to the last page, or by single chapters. This makes it possible for a reader who is interested merely in universal motors, for example, to read Chapter XII by itself without studying eleven chapters in which he is little interested. To accomplish this second purpose, a large number of cross references are given. Technical words and phrases are defined or informally explained in those places where such an explanation seems to be most appropriate and most easily understood.

A list of chapter headings follows: The Story Behind the Nameplate; What Makes an Induction Motor Run?; Single-Phase Induction Motor Windings and Connections; Split-Phase Induction Motors; Capacitor-Start Motors; Two-Value Capacitor Motors; Single-Value Capacitor Motors (Permanent Split-Phase Capacitor Motors); Multi-Speed Capacitor Motors for Fans and Blowers; Two-Speed Tapped-Winding Capacitor Motors; Repulsion-Start Induction Motors; Repulsion and Repulsion Induction Motors; Universal Motors; Shaded-Pole Motors and Fans; Polyphase Induction Motors; Synchronous Motors; Synchronous-Drive Motors and Position Indicators (Selsyn Motors); Direct Current Motors; Constructional Features Common to More Than One Type; Testing Fractional Horsepower Motors; and Supplementary Useful Information.

[*"Fractional Horsepower Electric Motors," by Cyril G. Veinott. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York. Cloth-bound; 6 x 9 in.; 431 pages; price, $3.50.*]

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Practical Heat

Practical heat is a new edition of one of the five books of the power plant series which was prepared a number of years ago by Terrell Croft. The purpose of the book is to discuss heat and the practical applications of heat in a manner which will make it possible for persons with a limited mathematical knowledge to follow intelligently. This edition, which is the second, has been edited by R. B. Purdy, who has attempted to maintain the author's style and simplicity of language and presentation while at the same time revising it so as to make it meet with present-day practice.

The first fourteen divisions of the book are devoted to the theory of heat and since this theory has not been changed, little revision has been done in this part of the book. The remainder of the book deals with the application of these fundamentals to power plants and as power plant practice has advanced materially since the first edition, this section has been extensively revised. A list of the division titles includes the following: Force, Pressure, Work, Energy, Power; Matter, Heat, Temperature; The Source of Heat; Heat—Its Measurement and Transformations; Transfer of Heat; Expansion and Contraction of Solids and Liquids; Heat Phenomena of Gases; Melting and Freezing of Substances; Vaporization; Steam and Other Vapors; Gas and Vapor Cycles; Fuels; Combustion; Steam Power Plants; Internal-Combustion-Engine Power Plants; Building Warming; Refrigeration; Instruments and Solutions to Problems.

[*"Practical Heat," by Terrell Croft and revised by R. B. Purdy. Published by McGraw-Hill Book Co., 330 N. 42nd St., New York. Cloth-bound; 5½ x 8¼ in.; 726 pages; price, $5.*]

Detection of Toxic Gases

These are three additional publications of a series of leaflets describing methods for determining low concentrations in the atmosphere of dangerous gases such as may occur in industrial buildings.

Leaflet No. 3 deals with a method by which concentrations of sulphur dioxide down to 1 part in 250,000 may be quickly determined by drawing air through chemically-treated filter papers and comparing the colored stains produced with standard colored charts.

Leaflet No. 4 describes a method by which concentrations of benzene vapor down to 1 part in 10,000 may be quickly determined. A sample of the atmosphere is drawn by means of a hand pump through a tube containing a re-agent until the re-agent assumes a certain standard depth of color. The concentration of benzene vapor present is derived from the number of strokes of the pump required to produce the standard color.

Leaflet No. 5 contains a description of a chemical test for nitrous fumes which is sufficiently sensitive to be readily capable of detecting a concentration as low as 1 part in 100,000.

[*"Methods for the Detection of Toxic Gases in Industry." Leaflet No. 3, Sulphur Dioxide; price, 75 cents; Leaflet No. 4, Benzene Vapor; price, 10 cents; Leaflet No. 5, Nitrous Fumes; price, 10 cents; all post paid. Published by the Department of Scientific and Industrial Research, British Government. Leaflets obtainable from the British Library of Information, 270 Madison Ave., New York, at the above prices.*]

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Air Conditioning

Most air conditioning books which have been written in the past have been prepared to serve the needs of the man with a limited education who either desires to get into air conditioning or who is in the field and desires to learn more about it. This book differs from the previous books in that it was prepared for engineering students in the upper college classes and for practicing engineers. In line with this the authors assume that the readers have some previous training in elementary thermodynamics and in the principles of engineering.

The authors have made a special effort to present the concepts and examples from a viewpoint of basic principles rather than from an empirical standpoint. While use of calculus has been made in certain derivations, it is done in such a manner as not to detract from the value of the book to those unfamiliar with this branch of mathematics. The length of the book is such that by judicious selection of material an ample coverage can be made by a college class meeting three hours a week for a semester. However, there is adequate material for a two-semester course if the various topics are considered in detail and if one or more basic design projects are carried through to completion.

Among the subjects covered are the following: The background of air conditioning; fundamental definitions—heat and thermodynamics; air and humidity calculations; air conditioning for human comfort; heat transfer and transmission coefficients; the heating load; cooling-load computations; steam heating; hot-water heating; warm-air heating; fluid flow, air-distribution systems; heat-transfer elements; boilers; air cleaning; refrigeration; control of air-conditioning refrigerating apparatus; and industrial air conditioning.

[*"Air Conditioning," by B. H. Jennings and S. R. Lewis. Published by the International Textbook Co., Scranton, Pa. Semi-flexible binding; 6 x 9 in.; 465 pages; price, $4.*]

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Limits of Inflammability of Gases and Vapors

A knowledge of the inflammable limits of various gases and vapors in air is of considerable importance in the prevention of explosions and fires in industrial plants. The list of substances now in use in industrial plants which may cause explosions is a large one and is growing every day. Information on the inflammability of these substances is in many cases difficult to find and what is available is not always consistent. In this bulletin the Bureau of Mines publishes the results of a comprehensive survey on the limits of inflammability of many substances.

The bulletin opens with a discussion of the conditions for propagation of flame in mixtures of gases and takes up such factors as the effect of small changes in atmospheric humidity, pressure, temperature and turbulence. The main section of the bulletin deals with reviews of experimental results of the limits of inflammability of a large number of gases, vapors and mixtures. At the end of this section is a table summarizing the data on the limits of inflammability. A bibliography with 267 references is also included. [*"Limits of Inflammability of Gases and Vapors," by H. F. Coward and G. W. Jones. Revised edition, 1938; Bureau of Mines bulletin No. 279. Paper cover; 6 x 9 in.; 146 pages. For sale by the Superintendent of Documents, Washington, D. C. Price, 20 cents.*]

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BRIEF REVIEWS

DICHLOROMONOFLUOROMETHANE. The thermodynamic properties of dichloromonofluoromethane in tabular form. Tables are the result of a research program undertaken to provide the refrigeration industry with tables of thermodynamic properties of this refrigerant which would be characterized by completeness in both the saturated and superheat ranges, thermodynamic consistency and a satisfactory degree of accuracy. Gives information on the physical properties of dichloromonofluoromethane and tabular material on the pressure, volume, density, heat content and entropy of the saturated vapor from 40F below zero to 160F above zero. Also gives the properties of superheated vapor from 40F below zero to 400F above zero for absolute pressures ranging from 1.2 lb. per sq. in. to 110 lb. per sq. in. [*"Thermodynamic Properties of 'Freon-21', Dichloromonofluoromethane, $CHCl_2F$." Published by Kinetic Chemicals, Inc., Tenth & Market Sts., Wilmington, Del. Paper cover; 8½ x 11 in.; 11 pages. Available on request.*]

EDITORIALS

Central Plant for Metropolitan Housing Project

This month we publish the first comprehensive description of the central station heating plant and distribution systems for the huge Parkchester apartment house group being erected by Metropolitan Life Insurance Co. in New York City. This project represents the greatest private onslaught in the movement to make attractive mass housing available. It will furnish living quarters for over 12,000 families and will thus be home to about 50,000 people.

With ample capital available and with the planning in the hands of well known technicians there were probably fewer restrictions around the planning than is frequently the case; certainly fewer than are encountered on the usual speculatively built apartment house. Here is a project which is being carefully watched by other investors and which, if successful, is likely to lead a movement toward construction of group apartment houses for permanent investment purposes. So also is the heating going to be watched by engineers and contractors to see to what extent a carefully planned and well executed central heating installation in such a project can be justified by its performance. Most engineers and designers have been saddened by the failure of apartment house builders—usually because of speculative motives—to take advantage of the economies possible by using good modern equipment instead of simply putting in something which will heat the building and which it is hoped will not fall apart until after the builder has disposed of the property.

It looks as if apartment house heating is finally going to receive the attention it has so long deserved. If so, this class of building represents a real opportunity for advances in methods and practices. We believe that everyone owes it to himself to watch these methods as they develop and to keep abreast of the advancing practices as they come along.

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Body Temperature and Medical Practice

On numerous occasions recently we have called attention to the high degree of interest being shown by physicians and medical researchers in the general subject of body temperatures, the body control of temperature, and the effects of outside influences on the body temperature. The subject is extremely broad and the ultimate findings are certain to greatly affect the practice of air conditioning for human comfort purposes. Most of the studies are still so fragmentary and incomplete that evaluation is just about impossible. About all that can be done is to record the findings as they come and wait until enough have accumulated to permit conclusions. This situation will surely continue as long as spectacularly promising leads are uncovered.

The most recent of these is the report of the studies made where cold baths or ice packs are used to bring the body temperature down to just under 90F and keep it there for long periods. Reports state that in some cases individuals have been subjected to such a treatment for a period of not hours but days with some curious results. Among these are a lowering of the basic metabolism, the slowing down or stopping entirely of some bacterial actions, and the production of a condition similar to hibernation. This treatment might be called a *cold shock* as opposed to the *heat shock* treatments which are also recent and which have attracted so much attention. At any rate they open up a whole new avenue of investigation.

It is quite possible that before long the physician will be able to hold the body temperature at any level desired for as long a period as desired and will be able to adjust it up and down at will to meet the needs of the patient. Just where in this process use will be made of air as the control medium or as the heat transfer device is not clear. Just now it is quite possible that conditioned air may be much used or may be ruled out altogether. That is why the whole course of these studies is of such vital interest to all of us.

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Marketing Methods

Within the past few weeks there have been important personnel changes in the ranking sales positions in several of the manufacturers of air conditioning equipment. Generally these changes have been in those companies which are trying hardest to perfect and market successfully some type of self-contained room cooler. Generally too such changes can be taken to mean that the managements are dissatisfied with the way things are going saleswise.

It is no secret through the industry that the hopes held for large volume sales of self-contained room coolers have not been realized especially in the small capacity sizes. It is also well known that these small coolers have been developed to a point where they can be had as strictly *plug-in* devices requiring only connection to an electric circuit in order to complete their installation. It was generally felt by their makers that these small coolers were the key to volume sales. They were put on the market at retail prices on a level with those obtained when huge numbers of kitchen refrigerators were sold some years ago. For some reason these small coolers have not sold in the expected volume. It can be concluded that changes in sales personnel have something to do with this situation.

Just where the manufacturers will go from here is by no means clear. Rumors are flying about ranging all the way from outright withdrawal from the field on the part of some makers to revamped plans and renewed selling pressure on the part of others. It is quite likely that there is some measure of correctness in all the rumors. Until the situation is clarified there is no reason to expect that everyone is going to adopt exactly like policies or plans. In the meantime don't forget that all this confusion over marketing plans detracts not at all from the merit of the unit room cooler as a piece of operating equipment.

NEWS OF THE MONTH

First Quarter 1939 Equipment Sales Show Gains Over 1938, Department of Commerce Figures Show

WASHINGTON — Almost without exception reports on heating and air conditioning equipment sales for the first quarter of 1939 exceed those of the corresponding quarter of 1938, according to a compilation based on numerous reports issued by the Department of Commerce.

The largest gain was that shown in the number of steel boilers which increased from 978 to 1989, a gain of 103.5%. The only equipment showing a decline were indirect heating surface for which orders, in dollars, declined 33.8% in the first quarter from the corresponding period in 1938.

Convectors are making still further inroads on direct radiator business, it is indicated in the reports, inasmuch as the sales of convectors increased 44.5% over last year while the sales of cast iron radiators rose only 12.2%.

Oil burners were up sharply in the first quarter, having registered a gain of 45.2%. This compares with an increase of 8.1% in the sales of domestic stokers. Commercial stokers, however, showed a good increase, the sales being up 22.2%.

Unit heaters reflected an increase of 32.3% while unit ventilator sales were up 35%. Due to a change in the method of reporting figures on the various types of air conditioning equipment, data for individual items are not comparable for the two quarters. Bulked together, however, the sales of this equipment in the first quarter of the current year total $5,618,000 as compared with $5,003,000 in 1938, an increase of 12.3%.

Reports of air conditioning added to the lines of 15 of the largest utilities throughout the country, however, during the first four months of 1939 show a slight decline, both in number of installations and horsepower added. During the first third of 1939 these fifteen cities reported 577 summer air conditioning installations totaling 25,216 hp. This compares with 651 installations and 25,765 hp. in the corresponding period of 1938, a decrease of 11.3% in number of jobs and decrease of 2.14% in hp.

Since these cities are typical large cities it would seem to lend some support to the argument that the increase in air conditioning as shown by the Department of Commerce figures is due to winter air conditioning rather than to summer air conditioning, although, on the other hand, it is possible that smaller localities are accounting for more summer air conditioning than previously.

The cities included in the summer air conditioning totals for the first four months included: Washington, Chicago, Indianapolis, Des Moines, Louisville, Boston, Detroit, Kansas City, Omaha, Cincinnati, New York (Manhattan only), Philadelphia, Dallas, Fort Worth and Houston.

The accompanying tabulation shows the itemized figures.

COMPARISON OF EQUIPMENT SALES, FIRST QUARTER, 1939 and 1938

EQUIPMENT	FIRST QUARTER 1939	FIRST QUARTER 1938	CHANGE PER CENT
Radiators, 1000 sq. ft.	9,651	8,606	+ 12.2
Convectors, 1000 sq. ft.	2,522	1,744	+ 44.5
Round Boilers, 1000 lb.	4,149	3,768	+ 13.8
Square Boilers, 1000 lb.	31,928	28,478	+ 12.1
Steel Boilers, number	1,989	978	+ 103.5
Oil Burners, number	24,004	16,510	+ 45.2
Large Ventilating Fans, dollars	551,946	518,379	+ 6.5
Refrigerating and air conditioning units, incl. winter conditioners, 1000 dollars*	5,618	5,003	+ 12.3
Air Filters, dollars	65,469	65,202	+ 0.4
Unit Heaters, dollars	1,299,442	982,022	+ 32.3
Unit Ventilators, dollars	735,010	544,684	+ 35.0
Indirect Heating Surface, dollars	234,445	352,802	— 33.8
Domestic Stokers, number	8,052	7,451	+ 8.1
Small Commercial Stokers, number	747	611	+ 22.2

*Due to a change in the method of reporting these statistics it is not possible to break down this group further and obtain comparable figures. The totals given, while not complete, are at least comparable.

Filter Study Continues at Institute

PITTSBURGH—Work is progressing at Mellon Institute on the investigation of materials of value for the construction of filters for air conditioning systems. The work is being carried on under a fellowship arrangement by the American Air Filter Co., Inc.

F. F. Rupert, the incumbent, is giving special attention to the chemical treatment and coating of steel wool and other filter materials to provide the greatest degree of durability and efficiency.

Second A.C. Exhibition Planned by Refrigeration Group

CHICAGO—A change in name has been adopted by the members of the Refrigeration Supplies and Parts Association which will now be known as the Refrigeration Equipment Manufacturers Association. The change was voted at a recent convention in French Lick Springs, Ind.

In addition to the change of name several amendments were made in the by-laws. Prominent among these is a shift in the arrangements for the membership meetings of the organization. Hereafter the official annual meeting will be held in the spring with a short mid-winter meeting during the exhibition week, in place of the former formal business meeting during the show with a spring meeting later in the year.

Of particular interest to the trade was the decision made by the general committee in charge of the Second Annual All-Industry Refrigeration and Air Conditioning Exhibition to hold this show during the week beginning January 15, 1940. The committee also announced that already six national technical and trade organizations within the industry have definitely accepted invitations to hold their annual meeting or convention in Chicago in conjunction with this exhibit. Action on similar invitations from several other such organizations is anticipated in the near future. Members of the exhibition committee are: M. W. Knight, chairman, Peerless of America, Inc.; F. J. Hood, Ansul Chemical Company; H. T. Hulett, General Electric Company; A. B. Schellenberg, Alco Valve Company; K. B. Thorndike, Detroit Lubricator Company; R. M. McClure, secretary and exhibition manager.

Battelle Will Build Conditioned Lab

COLUMBUS, OHIO — Contracts have been let by Battelle Memorial Institute for the construction of a new research laboratory to take care of the expanding volume of industrial research. The increased space is necessary due to the growing research activity in metallurgy, fuels, ceramics, and chemistry.

The new construction consists of a wing extending from the end of the present main building that will provide approximately 50,000 square feet of space on five floors. In this will be chemical and metallurgical laboratories, photographic and metallographic departments, physics laboratories, and a large industrial laboratory. Constant temperature and controlled humidity rooms will be provided for chemical and metallurgical studies.

Fan Makers Appoint Committees

DETROIT—President Henry Mathis of the National Association of Fan Manufacturers has announced the following committee appointments for the ensuing year: By-Laws, J. M. Birkenstock; Credit, H. S. Whiting; Engineering, G. S. Polk, chairman; Finance, W. Gardner; Legislation, E. B. Freeman; Membership, E. Szekely; Publicity, J. M. Frank; Standards, F. Herlan, chairman; Statistical, F. Herlan, chairman; Trade Relations, J. E. Truitt; Transportation, O. B. Coblentz; N.A.F.M. representative on blower systems, N.F.P.A., J. O. Lennon.

NAFM Elects Mathis President

DETROIT—The National Association of Fan Manufacturers at its annual meeting in Buffalo, April 12, elected H. Mathis as president; C. T. Morse, vice-president, and L. O. Monroe as secretary-treasurer for the ensuing year.

The next meeting of the Association is to be held in New York June 20.

New York ASHVE Elects Oakes

NEW YORK—The New York chapter, ASHVE, closed its 1938-39 season with its annual stag social meeting at the Building Trades Club. Humorist Bob Willis from radio station WOR spoke.

Officers for the coming year were announced as follows: president, Orion O. Oakes; vice president, Charles S. Pabst; treasurer, W. M. Heebner; secretary, T. W. Reynolds; board of governors, Howard G. Meinke, Alfred L. Browne and Harry L. Baker, Jr.

Phila. Chapter Holds Golf Meet

PHILADELPHIA—The annual outing of the Philadelphia chapter, ASHVE, was held May 10 at St. David's Golf Club, Wayne, Pa. According to word received from William P. Culbert, chairman of the golf committee, the prize winners were Kicker's Handicap, members, C. Coward, P. L. Davidson, F. J. Wilson and C. B. Eastman; guests, Jos. Stecher and G. P. Alexander; Low Gross, member, Wm. P. Culbert; guest, E. C. Powers; Door prize, member, A. P. Shanklin; guest, Leo Garrity.

F. J. Kurth Addresses Chicagoans

CHICAGO—F. J. Kurth, vice-president of the Anemostat Corporation of America addressed 123 engineers, contractors and technicians on April 24 at the meeting held at the Merchants & Manufacturers Club in the Merchandise Mart. The title of Mr. Kurth's talk was "The History and Theory of Air Distribution."

Dental Laboratories and Powder Plants Have Dust Hazards, N. Y. State Body Reports in Annual Review

NEW YORK—Notable accomplishments in decreasing health hazards in industry during 1938 have been reported by the Division of Industrial Hygiene of the New York State Department of Labor in a review of the Division's activities during the past year. Included in these activities are those related to dusty trades and ventilation.

In connection with dusty trades the Division reports that the attack on such a problem consists of first, by means of medical studies, appraising the hazards in terms of the toxicological effects of the substances involved; then measuring the intensity of exposure by means of air analyses and dust counts, and finally the formulating of regulations and codes to prevent exposure of workers to injurious concentrations of the substances.

Workers who must be protected can be divided into two groups—those exposed to dusts known to be seriously injurious to the lungs such as silica or asbestos; and those exposed to so-called non-injurious dusts, hitherto regarded as innocuous but which there is reason to believe may nevertheless be responsible for various troubles in the respiratory tract.

In connection with the silica dusts the Division has reviewed its activities in connection with rock drilling, with operating conditions in factories, studies carried on in a granite cutting shed, a study of scouring powder manufacturing plants, and work in connection with dental laboratories and phonograph record factories.

The X-ray plates of workers in scouring powder plants are now being analyzed in an effort to determine the degree of hazard in this type of work. An unexpected silicosis hazard has been unearthed in dental laboratories due to the abrasive used there. During the year improved ventilation has been installed in a phonograph record plant which, it is believed, should lead to safer working conditions in that factory. The whole situation in this type of plant is under investigation.

During recent months the Division has embarked on a comprehensive investigation of the so-called non-injurious dusts including wood dust, grain dust, fertilizer dust, wool dust, and others.

In connection with noxious fumes and gases the studies have been conducted on benzol, trichlorethylene, and chlorinated naphthalenes and diphenyls. Benzol is used in the printing trades, trichlorethylene is used in connection with degreasing, and chlorinated naphthalenes and diphenyls are used in the manufacture of electrical condensers and wire insulation.

In its operation in connection with industrial ventilation, engineers during the past year have been engaged in three types of work:

(1) Appraisal of the efficiency of specific ventilating systems (such work is usually done at the request of an employee for advice on a special problem); (2) Studies of special processes or substances to determine whether the exposure to a substance is injurious to health; and (3) Examination and approval of exhaust systems which have been installed.

New York Hotel Gets A.C. Units

NEW YORK—The Hotel Pennsylvania has placed in service a hundred air-conditioning units in the hotel's guest rooms.

All the Pennsylvania's important public rooms, including the Cafe Rouge, cafe, cocktail lounge, the new coffee shop and the barber shop, as well as the grand ballroom and the other function rooms on the ballroom floor, are already air-conditioned from a central unit. However the new guest room units are the first to be put into operation in the hotel's projected campaign to equip guest rooms for greater summer comfort.

Locomotives Heat Shoe Factories

NORWAY, ME.—When the heating plant serving two shoe factories of this town went out of commission recently and 1100 employes faced loss of work, a shutdown was avoided by the loan of two Canadian National Railways locomotives. These were connected to the heating circuits and furnished live steam to maintain working temperatures. A Maine state trooper, Eugene Stevens, formerly a railway fireman, acted as fireman and plant engineer on the stationary locomotives during the emergency.

Aluminum Discussed at Pittsburgh

PITTSBURGH—The May meeting of the Pittsburgh chapter, ASHVE, held May 8, had as its main feature a talk by Paul V. Faragher who spoke on the Scientific Development of Aluminum. This was followed by the showing of a sound movie, "Aluminum Mine to Metal."

Chicago Adds 88 Conditioning Jobs

CHICAGO—The Commonwealth Edison Co. reports the addition of 88 central air conditioning plants and room coolers to its lines during the month of April, totaling 633¾ tons. Three theater jobs of 50-tons each were the largest installations during the month.

Smithsonian Scientist Finds Sunspot Cycle of 89.36 Years; Discovery May Aid Long-Range Forecasting

WASHINGTON — A new fundamental time division—the 89.36 year sunspot cycle—has just been introduced by H. Helm Clayton in a report on mathematical analysis of solar activity just issued by the Smithsonian Institution. By means of it, Mr. Clayton shows, he can make fairly accurate predictions not only of the times of recurrence of maximum and minimum numbers of these titanic whirlwinds in the sun's atmosphere of fire, but also their amplitude at different recurrences.

The great cycle in turn is split into eight component cycles. These might be likened to eight "seasons" on the sun, due to some unknown factors in its own physical constitution. Sunspots are attracting constantly more and more attention because of their known and suspected correlations with conditions on earth. They are known to affect the earth's magnetic field, and consequently radio transmission. They are strongly suspected of exercising a dominant influence over weather.

Up to the present, however, means of predicting them have been quite unsatisfactory. It has long been known that there is a basic sunspot cycle, during which the spots increase from minimum to maximum numbers and back to minimum again, which repeats itself approximately every 11 years. This, however, is only an average. In the past 150 years it has been as short as 9 years and as long as 13 years. Nobody has been able to predict with any confidence when a cycle would repeat itself.

It also has been impossible to predict very accurately the amplitude of either minima or maxima. At some of the 11-year recurrences the sun has been far stormier than at others It has just passed through one of the most tempestuous periods known since sunspots have been under observation and now is on its way back toward "fair weather" once more.

The trouble has been that the 11-year cycle is just an approximation. It is made up, as has been demonstrated notably through the researches of Dr. Charles G. Abbot, secretary of the Smithsonian Institution, of several constituent cycles. The maxima and minima of several of these cycles tend to come together approximately every 11 years. These minor cycles are of varying length and amplitude. They appear at first to be inextricably confused. The minimum of one may occur at the maximum of another, reducing its normal amplitude. Or two or more maxima may occur together, raising the amplitude far above normal. The problem has been first to compute the normal lengths and amplitudes of these cycles and then to determine the points of their concurrences.

This has involved very laborious statistical procedures. Mr. Clayton has analyzed the yearly sunspot data since 1793, or as long as entirely reliable records have been kept. He finds a constant recurrence of eight cycles, one of which is the basic period which he recalculates at almost precisely 11.17 years. The others are 5.56, 8.12, 8.94, 9.93, 11.14, 14.89, 19.86 years, respectively. All are very nearly submultiples of the fundamental period of 89.36 years, a period in which all their concurrences will have taken place. This, then, becomes the major sunspot period, and the one upon which predictions must be based.

McIntire Visits Northwest Group

PORTLAND, ORE.—On a tour of the Pacific northwest and the west coast, James F. McIntire, Detroit, president of the ASHVE, was the principal speaker and guest of honor at a special gathering of heating and ventilating engineers of the region late in April. Mr. McIntire outlined "The Birth of Air Conditioning and its Future" with numerous illustrative incidents of its progress. The president of the society conferred with local members while in the Pacific northwest area.

The meeting at Portland was widely heralded with invitations to participate extended to leading architects as well as heating and ventilating engineers and contractors in Portland and vicinity. These invitations were issued by J. Donald Kroeker, Portland consulting engineer, who made arrangements for the dinner meet April 27th, and Harry K. Mead, of Portland, representative of the Pacific Steel Boiler Division of the United States Radiator Corporation.

Danley Elected President of ACMA

HOT SPRINGS, VA.—P. Y. Danley, Westinghouse Electric & Manufacturing Company, Springfield, Mass., was elected president of the Air Conditioning Manufacturers' Association at the Association's annual meeting here May 13. Other officers are S. E. Lauer, York Ice Machinery Corporation, vice president; P. A. McKittrick, Parks-Cramer Company, treasurer; and W. B. Henderson, executive vice president.

The Board of Directors for the coming year includes J. F. G. Miller, B. F. Sturtevant Company, chairman; Stuart Crocker, General Electric Company; E. T. Murphy, Carrier Corporation; J. A. Harlan, Nash-Kelvinator Corporation; J. M. Fernald, Baker Ice Machine Company; F. D. Kirk, Vilter Manufacturing Company, and the Association's officers.

Dr. Young Praises Hospital A. C.

BUFFALO—Air conditioning was described by Dr. Albert G. Young, medical director of Corey Hill Hospital, Brookline, Mass., as a new tool for the treatment of disease and an effective aid to public health.

Addressing a joint meeting here of the Air Conditioning Council of Western New York and the Erie County Medical Society, Dr. Young declared an intensive research into the physiological effects of air conditioning has shown weather control to be an aid to sufferers from post-operative pneumonia, rheumatism, hay fever and heart disease.

Dr. Young described the reduction in post-operative pneumonia cases through air conditioning, as the most startling discovery of the study. Of 2110 surgical operations performed in the last 2½ years, he declared, "only one quarter of one per cent were followed by post-operative pulmonary complications, compared with an average of 6 or 7% in non-air conditioning hospitals. Likewise," he added, "post-operative mortality dropped sharply."

Time spent in confinement by rheumatic fever patients has been cut 40% by conditioning, Dr. Young said.

W. A. Grant Addresses Phila. Group

PHILADELPHIA—Correct zoning of air conditioning systems to provide utmost flexibility in operation was described by Walter A. Grant, district chief engineer for Carrier Corporation, in an address before the Philadelphia Chapter of the ASHVE, as "one of those intangibles in design which distinguish the quality system from the mediocre."

He explained that zoning divides an air conditioning system into sections to provide the desired air conditions to meet the varying requirements of each zone.

"Since zoning may well be the controlling factor in ultimate buyer satisfaction, engineers are today realizing more and more that good zoning is becoming an essential factor in insuring the success of modern air conditioning projects.

"The ultimate test of the economic worth of air conditioning is measured by the physical comfort of the occupants. Since individual preferences vary rather widely, the successful air conditioning system must be conceived to satisfy the greatest possible percentage of the people who are to reap its benefits.

"This focuses attention upon the importance of flexibility in the design of systems; so that they may respond to hourly and seasonal variations in outside conditions and at the same time satisfy these varying individual requirements."

Bellamy Reviews Progress of Air Conditioning with Gas in Paper at Convention of Natural Gas Section, American Gas Association, at Tulsa, Okla.

TULSA, OKLA.—One of the outstanding papers of the annual convention of the American Gas Association, held here May 8-11, was that presented by Charles R. Bellamy of the Columbia Gas & Electric Corp., and chairman of the industrial and commercial air-conditioning committee of AGA.

Mr. Bellamy's paper was entitled "Reaching the Air Conditioning Market through the 1938-39 Developments in Gas Equipment" in which the speaker presented a comprehensive analysis of the air conditioning market from the standpoint of the gas utilities. He urged his audience not to be discouraged about air conditioning merely because it did not live up to the phenomenal claims made for its future a few years ago, and pointed out that even if the growth of air conditioning had not been staggering, nevertheless, it had been steady and sharp. He referred to the fact that in 1938 when general business had declined over 20% from the preceding year, air conditioning declined only 11%. Mr. Bellamy analyzed the market and, in addition, referred to a research now under way on air conditioning and its relation to the medical field. Following this, he outlined the equipment now available for the gas utilities to supply the air conditioning market. Abstracts from this part of Mr. Bellamy's paper follows:

"The 1938-1939 developments in gas-fired air-conditioning equipment have been altogether favorable from both technical and commercial standpoints. Old types of equipment have been improved and costs greatly reduced. New types of equipment have been developed and are not on the market. As a result gas equipment is now available to produce manufactured weather either by dehumidification and supplementary cooling or wholly by refrigeration, and in either case it can meet the competition of the conventional electric system. Furthermore, the possibilities of further price reductions under mass production methods appear to be far brighter for gas equipment than for electric. In short, the gas industry has the necessary tools and can confidently enter the air-conditioning business.

"The gas industry became interested in air-conditioning through the dehumidification process. The silica-gel process was the first to use gas in air-conditioning work. Later the Kathabar process, employing lithium chloride, was brought out, and both processes have been on the market for a number of years and have to their credit many successful installations among which are some of the country's most important jobs. In addition, there is the Lectro-dryer process, employing activated aluminum, which has been used very effectively in drying problems and offers promise for air-conditioning, particularly in the industrial field. All of these processes have certain inherent advantages, but except where inexpensive cold water was available they have heretofore not been able to provide complete air-conditioning and frequently have had to be used in conjunction with a refrigeration system. Obviously, the first cost of a split system employing one of the above processes for dehumidification and an electric unit for compression refrigeration is higher than the cost of a conventional straight electric system. The split system, of course, provides Cadillac-car performance, but the market for such systems naturally is limited in size. Hence, the need for gas dehumidification systems that would provide complete air-conditioning at a reasonable first cost and low operating expense. The progress that has been made in this direction during the past fifteen months, I think, can conservatively be called remarkable. Let us see what has been accomplished.

"The Kathabar equipment using lithium chloride was until approximately a year ago custom built for each job. This meant high cost for equipment as well as high engineering cost for the installation. Within the past year, however, the equipment has been re-designed and greatly improved. The new design calls for standard cells for contactors, each cell having a rated capacity of 2500 C.F.M of air and being approximately 26 inches wide by 36 inches high and 31 inches in depth. These cells are now nested in frames similar to filters, and in that manner built up to provide a system of any desired capacity. The compactness of the new design is such that space requirements have been materially reduced; in fact, in many situations the new equipment will require less than half as much space as the old design. As a result of this standardization and improvement and simplified design it has been possible to reduce the price of the Kathabar unit and likewise the cost of installation. Surface Combustion Corporation estimates that at least a 30% reduction has been effected in cost during the past year or two. Certainly the competitive possibilities of this equipment have been stepped up notably.

"In addition, a new series of Kathabar package units is being put out ranging in capacity from 2500 C.F.M. to 6000 C.F.M.; these units being designed to give maximum performance with a low over-all cost. They are assembled practically complete at the plant and shipped out to the user in such a state of completion that the ordinary mechanic can place a unit in operation. This is a big step forward.

"Looking to the future, Surface Combustion Corporation is at work on a domestic unit that will provide year-'round air-conditioning, that is, winter heating and humidifying and summer cooling and dehumidifying. One of the characteristics which has already been built into this proposed domestic unit is the ability to circulate all the air through the lithium chloride each time that it passes through the circulating fans, thereby obtaining the cooling and purifying effect of the lithium chloride on the recirculated air. With this arrangement it appears possible to design equipment for year-'round air-conditioning in a comparatively small compact unit. Further information about this development may be expected soon since it is hoped that a unit can be put on test this summer.

"On March 29 The Bryant Heater Company of Cleveland introduced to the gas industry a new series of dehumidifiers radically different, mechanically, from their former models. They are similar in two respects only: gas is used as the primary source of energy, and silica gel is used as the adsorbent, or moisture extracting material. The silica gel basket is placed in the machine in a horizontal position, i.e., the principal axis is horizontal. It rests upon two shafts, which are parallel to the axis of the basket, and these shafts in turn are supported on ball bearings attached to the base of the machine. The supporting shafts are turned by a small electric motor having a suitable gear reduction; the shafts in turn cause the basket to rotate. One revolution of the basket takes 9½ minutes.

"These machines are continuous machines in every respect. Saturated silica gel moves continuously into the activation or heated section to be dried out, thence to the cooling section, and then back again into the 'wet air' or adsorption section where it is put back to work.

"Silica gel is really a heat transformer, changing latent heat to sensible heat. In less technical language, it condenses the water vapor or steam out of the air which is being dried into its sub-microscopic pores. This condensation liberates the heat of vaporization of the steam, which is about 1060 B.t.u. for every pound of water condensed. The heat must be dissipated somewhere; it appears in the dry air as elevated temperature.

"The temperature of the dry air will range from 125° to 150°, depending upon the amount of water in the wet air and its temperature. Because of this high temperature, the dry air may be returned to normal temper-

ature by passing it through an indirect cooling surface or coil which uses tap or cooling tower as a cooling medium. Thus, the combination of a dehumidifier and tap water cooler constitutes a moisture removing apparatus which does not resort to low-temperature or refrigeration cooling.

"While air is being dried, as explained above, by one portion of the rotating gel basket, the other portion is being activated and cooled. The activation air is heated to about 325F before it enters to gel to drive out the adsorbent moisture. The leaving temperature of this air is about 150F.

"Bryant's new dehumidifiers are so low in cost that another step may economically be added to this system for the air conditioning of residences and small commercial installations. Formerly, because of cost, to obtain the cooling or temperature reduction necessary in all comfort installations, either cold water from taps or wells, or mechanical refrigeration, was required to supplement the dehumidifier to make up the complete job. Now, resaturating cooling may be used. Simple, this consists of using extremely dry air, cooling this air in the dry-air cooler with whatever water is available, *and then spraying water back into the over-dried air.* The evaporation of water into this air will lower its temperature, but not enough water is added to nullify the drying effect on the conditioned space. Thus, with resaturation cooling added, the industry has a complete cooling and dehumidifying unit, competitively priced, which still incorporates inherently to a large degree the great advantage of independent temperature and humidity control.

"One of the most remarkable features about this development is that these improved dehumidifiers which provide complete air-conditioning are being offered at just one-half the price of the former models. It is difficult to evaluate the full importance of this price reduction in terms of market possibilities, but a better machine at half the price is an outstanding achievement in any industry.

"On a subject as involved as air-conditioning it is not surprising that there should be a difference of opinion among gas men as to the best ways and means of accomplishing given results. Some are very loyal to their first love, dehumidification, and believe that it contains the answer to all air-conditioning problems and that refrigeration is an unnecessary evil. Others in our group have felt the need of a gas-fired absorption refrigeration system and in their opinion it was necessary for the gas industry to have both dehumidification and refrigeration equipment of the highest quality in order to play its proper role in air-conditioning. It is not my intention to enter any controversy regarding whether or not refrigeration is an essential part of air-conditioning. There is no need to play any favorites, for the developments to date have been equally encouraging and favorable to the pros and cons of this issue.

"The first gas-fired absorption refrigeration process for air-conditioning to be placed on the market is that manufactured by the Williams Oil-O-Matic Heating Corporation and called the Williams Air-O-Matic refrigeration unit. This machine, I believe, also has the distinction of being the premier unit to provide cooling and dehumidification in summer, heating and humidification in winter, together with ventilation, air circulation and cleansing throughout the entire year. It is a brand new tool for gas which has required patience, engineering skill, time and much money to develop. A few of these units were installed on utility properties during 1937 and 1938 and only after their performance had been carefully checked was the machine placed on the market. Commercial production was initiated early this year, and the 1939 production schedule calls for 2,000 tons of refrigeration effect.

"One of the features of the Air-O-Matic apparatus is its inherently low working pressure. The low side pressure in this machine will ordinarily be within the range of 21 to 24 inches mercury vacuum and the operating high side pressure within a range of 3 inch vacuum to 4 pounds gauge. The four major parts of this machine are (1) absorption unit, to provide refrigeration for comfort cooling (2) water cooling equipment, to dissipate heat liberated by the absorption machine, (3) air distribution unit, to provide air circulation, positive ventilation, air cleaning, cooling and dehumidification, heating and humidification, (4) control system, to regulate the climate in the air-conditioned space.

"Some time during the year it is expected that two other companies, namely, the Mills Novelty Company and Servel, Inc., will have important announcements to make regarding new gas-fired absorption refrigeration equipment for air-conditioning. Both of these companies have been carrying on extensive experimentation along this line for some time and are now making practical field tests on their air-conditioning machines.

"The Mills gas-fired absorption refrigerator is a novel application of the well-known ammonia evaporation-absorption cycle. It performs the two functions of this cycle without mechanical devices or moving parts, by means of pressure differentials and gravity. For the present the capacity of this machine is rated at 18,000 B.t.u. of refrigeration effect per hour, equal to 1½ tons. One of the interesting objectives of the builders is to produce a low cost unit suitable for conditioning medium size and small homes.

"The fact that the Servel Company has developed a gas-fired air-conditioning system probably will occasion but little surprise among gas men. It is such a natural expansion step that its anticipation has been pretty general throughout our industry.

"The new Servel unit is intended for all-season air-conditioning purposes, that is, heating and ventilating, ventilating only, and cooling and ventilating, at the choice of the user. Very little publicity has been given to this development so far, but the Servel Company has made an installation in the Good Housekeeping Model Home at the New York World's Fair and is planning some field installations this summer, probably in this section of the country.

"In the Servel unit cooling is obtained by using a closed absorption refrigeration unit in which the refrigerant is water and the absorbent is lithium chloride solution. The unit is hermetically sealed and there are no moving parts in the refrigerating system. Since water is the refrigerant the unit operates at a high vacuum. The generator is heated by steam from a gas-operated atmospheric steam producer located in the lower part of the unit.

"When operating to produce heat in the winter the same burners and steam producer are used as supply heat for the cooling unit in the summer. In the winter the steam is directed to a heating coil which is in the air stream. In changing from heating to cooling, and vice versa, it is necessary to open one valve and close the other.

"In connection with the utilization of the absorption refrigeration system for air-conditioning there is one point that I think we should all keep in mind; namely that straight refrigeration units are alike in their ability to control humidity regardless of whether they are gas-fired or electrically driven. Their control of humidity is indirectly achieved by their control of temperature. Frequently the temperature reduction essential to proper humidity control is far greater than that called for by the comfort air cooling requirement, and when the air is thus over-chilled its temperature should be restored to the proper point by reheating. In this respect the new gas absorption processes are similar to the conventional compression units. In many situations it may be more economical to employ a split system, that is, one with independent dehumidifier and refrigeration units, rather than have a straight refrigeration system carry the excess refrigerating load of dehumidification together with the expense of re-heating. This is a point that should be examined carefully whenever a refrigeration system of any type is to be installed for air-conditioning.

Chain Store Conditioning Gains, National Survey Shows

NEW YORK—Chain store installations of air conditioning in 1939 are expected to surpass their 1937 peak, according to a nation-wide survey by *Chain Store Age*. During 1937 installations in chain stores, the publication reports, reached nearly 11 million dollars. This dropped to 8¼ million during 1938. The total number of chain stores conditioned are reported to be 6.1% of which 1.4% were conditioned during 1938.

Grocery chains have more units conditioned than all the others combined in spite of the rather small percentage of such stores that are conditioned. Last year drug chains conditioned 5.9% of their stores in their field bringing the total with air conditioning up to 26.7% of all chain drug stores.

Apparel stores were second, conditioning 5.1% of their stores last year bringing their total to 23.8%. Restaurant chains were third, with 4.2% conditioned in 1938 and a total of 18.6%. Shoe chains conditioned 1.6% of their stores, making their total 12.5%.

Of the major fields in which mass distribution operates, this leaves variety and department stores. While the first of these conditioned only 1.5% of their stores in 1938, making the total 4.7%, they spent by far the largest sum on the work—$1,010,700—and the survey showed that their executives are enthusiastic about air conditioning's results.

Bichowsky Addresses Detroiters

DETROIT—The April meeting of the Michigan chapter, ASHVE, was held at The L'Aiglon, April 17. There were approximately 60 members and guests present.

C. T. Olmsted, secretary of the state board of registration of professional engineers, discussed the recently enacted registration act. He pointed out that in order to register without examination, an applicant must have had 12 years of experience of a responsible character prior to Jan. 1, 1938.

The second guest speaker was Dr. F. R. Bichowsky, consultant engineer for the Dow Chemical Company. Dr. Bichowsky spoke on "Dehumidification in Air Conditioning" with particular reference to industrial applications. He discussed some of the advantages and disadvantages of silica gel, lithium chloride, activated aluminum, and calcium chloride.

Hugo F. Hutzel, Nash Kelvinator Company; C. F. Cushing, Bryant Air Conditioning Corporation; and R. B. Derr, Aluminum Company of America, discussed Dr. Bichowsky's paper.

Propeller Fan Makers Organize and Elect Bauer President

DETROIT—The National Association of Fan Manufacturers, due to the increasing use of propeller fans in the field of ventilation, has sponsored the formation of a new association known as the Propeller Fan Manufacturers Association. By-laws have been officially adopted.

M. W. Bauer of the Aerovent Fan Co. has been elected president, A. R. Stephen of the DeBothezat Ventilating Equipment Co., vice-president, and V. C. Shetler, secretary-treasurer.

Charter members consist of Aerovent Fan Co., Air Controls, Inc., American Blower Corp., American Coolair Corp., Autovent Fan & Blower Co., Buffalo Forge Co., Chelsea Fan & Blower Co., DeBothezat Ventilating Equipment Co., Hartzell Industries, Inc., Ilg Electric Ventilating Co., International Engineering, Inc., Marathon Electric Manufacturing Corp., Peerless Electric Co., Propellair, Inc., and Viking Air Conditioning Corp.

The Association is working on and will officially adopt a certified rating label which will be issued only to those member companies whose ratings and tests are in accordance with the Standard Test Code for Centrifugal and Propeller Fans.

Boston District Heat Men Meet

BOSTON—Members of the Boston section, National District Heating Association held its spring dinner and meeting at the University Club May 9. The subject of discussion by the speakers was "utilization" of the various services required in the conduct of commercial and industrial undertakings. Raymond M. Nee of Boston Edison Company's district steam department, spoke of the "Theories and Principles of Utilization," his talk, like the others, being followed by a discussion period. D. W. Blair of the Boston Edison Company spoke on "Practical Applications of Utilization Principles," and F. Guth, chief engineer of the Hotel Touraine, on "An Operating Engineer's Use of Utilization Principles."

6057 Hp. of A.C. Added in New York

NEW YORK—Seventy-seven air conditioning installations totaling 4500 hp. were added to the lines of the Consolidated Edison Co. of New York, Inc., in Manhattan during the first quarter of 1939. The same company reports 38 installations totaling 1404.5 hp. added in Queens during the first quarter, four installations totaling 38½ hp. added in the Bronx during the first quarter, and eight installations totaling 114 hp. were added in Brooklyn during the first quarter.

A. C. Furthers Color Photography, Used by Leading Professionals

NEW YORK—The second annual exhibit of color photography, opened at 50 Rockefeller Plaza, June 3, has been made possible by the development of air conditioning to its present high standards. The exhibit, international in scope, includes the work of about thirty-five of America's best known commercial color photographers, and shows the brilliant development of color photography today.

Air conditioning is essential in both the manufacture of materials for the tricolor carbon print, used today by almost all the leading professional photographers, and for the developing of a color print as well.

In the manufacturing process the essential paper for the print is basically a gelatine coated paper. A blast of cold air is made to hit the coated paper, cooling and setting the gelatine to prevent it from running. After this treatment a large volume of water must be taken out of the air to ensure the rapid drying of the gelatine. This entire process is accomplished with the usual air conditioning apparatus, by cooling the air to the dewpoint, then reheating.

After the paper has dried it is necessary to reverse the de-humidification process and add water to the air to make the gelatine coated paper pliable.

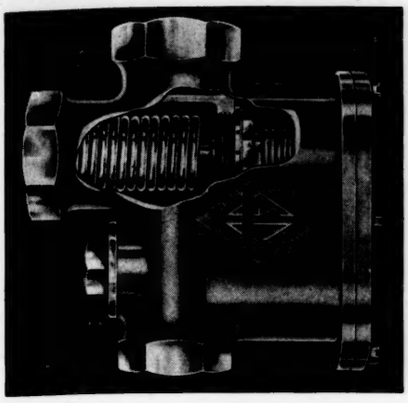
In the professional developing laboratories air conditioning is used for the finest color photographic work to maintain temperatures below 75F. Above this temperature gelatine used in the color printing melts or loses its tensile strength. In this field the primary control is one of temperature.

Among the outstanding color photographers whose work will be shown in the exhibit are: Bruehl, Hesse, Keppler, Harrer, Muray, Outerbridge, and Sarra. About twenty-five representations of outstanding amateur color photography will also be shown. The exhibit, sponsored by the Devin Colorgraph Co., is the only art show devoted exclusively to color photographs in the country. It will run to June 16, and is open to the public from 10 a.m. to 10 p.m.

A. C. for South Jersey Hospital

WOODBURY, N. J.—Announced as the first installation of its kind in South Jersey, Underwood hospital here will be air conditioned. The contract calls for installation in two operating rooms and in the labor and delivery rooms of the hospital's maternity department. Also, mechanical changes will be made in the windows of private rooms to accommodate portable summer conditioning units for patients when specified by their physicians.

NEW EQUIPMENT

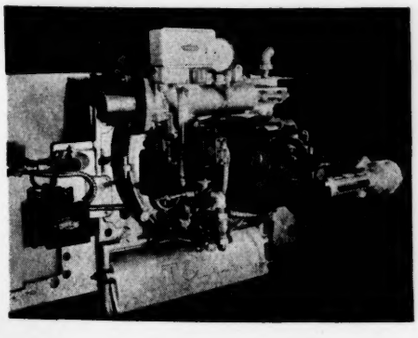


Gerstein & Cooper Tempering Valve

NAME—G & C tempering valve.
PURPOSE—For the automatic regulation of water temperature.
FEATURES — Valve is made entirely of bronze and the actuating bellows and all operating parts are out of the water. Valve can be used wherever the water supply is above 150F and is factory set to deliver water at 140F. There is a range of adjustment which makes possible water deliveries from 100 to 200F outlet water temperatures when the domestic hot water is heated sufficiently. Valves are furnished in 1 in. size only but can be bushed to take ½ or ¾ in. pipe.
MADE BY—*Gerstein & Cooper, South Boston, Mass.* *1*

Todd Rotary Oil Burner Control

NAME AND MODEL NUMBERS—Todd rotary fuel oil burner, Types P.A.H. and P.A.
PURPOSE—For burning any commercial type fuel oil under fully automatic control for heating schools, apartment houses, small buildings, hotels, office buildings and factories.
FEATURES—While the basic principles of the rotary burner have been retained, this model has been completely redesigned and proportioned to allow ample clearances and generous air and oil passageways to promote quiet and efficient operation. The burner unit is arranged in combination with an integrally driven oil pump and control devices so that it is provided with completely built-in equipment for proper handling and treatment of the heaviest grades commercial fuel oil. Where the application does not justify the use of heavy oil requiring preheating, the burner is furnished basically as for heavy oil application but without such equipment as is essential for temperature control of the heavier oils. This feature makes it possible for conversion to heavy oil operation simply by adding the extra equipment. Gas-electric ignition is provided as standard equipment upon all a.c. powered burners and control of the burner under full automatic operation may be from either a temperature limit source or from a pressure control. The relay equipment incorporated as standard equipment with the burner is the new Minneapolis-Honeywell Regulator Co. Type R-157-1 which provides post ignition and recycling features. This relay permits a flame failure to occur once without the relay locking out on safety and provides for a scavenging period of approximately 3 min. after the initial flame failure before recycling the ignition sequences. The illustration shows the Type P.A.H. burner.
MADE BY—*Todd Combustion Equipment, Inc., New York*..... .....*2*

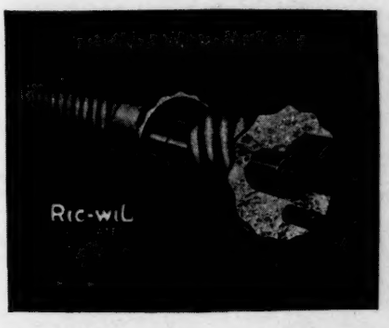


Herske & Timmis Heating Control

NAME—HT automatic heating control.
PURPOSE—For the control of steam heating systems in multi-occupancy buildings using either oil burners, stokers or gas burners.
FEATURES—Control is mounted in a steel cabinet which is fastened to wall in boiler room or wherever desired in building. It is connected to the pressure switch, line current and the firing device. In the control box is a weather-comfort dial which the building custodian sets in accordance with the weather.
METHOD OF OPERATION—When operating on the weather-comfort control dial the control starts the firing device and keeps it on until the pressure switch is satisfied, at which time the firing device is stopped. The cut-off point of the pressure switch is set at whatever pressure will cause circulation of steam to all radiators. After the pressure switch is satisfied the control keeps the firing device off for a period determined by the weather-comfort control dial. These delayed off periods are 10, 15, 20, 25, 30, 40, 60 and 120 minutes. The colder the weather the shorter the off period, the warmer the weather the longer the off period. The weather-comfort control dial is marked with weather indications so that the operator can easily choose the correct setting. A clock switch automatically turns off heat at any desired hour at night and turns it on again to full heat under control of the presure switch at any time in the morning. At the end of the heating up period, which can be of any desired length of time, control is restored to the weather-comfort control dial.
MADE BY—*Herske & Timmis, Inc., New York.* *3*

Ric-wiL Metal Steam Conduit

NAME—Ric-wiL insulated pipe units.
PURPOSE—For underground distribution of steam.
FEATURES — Units are of the self-contained sectional type completely assembled including steam pipe, supports, insulation, metal conduit housing and all accessories delivered in a prefabricated form all ready for the field welding. Material for conduit itself is Armco Hel-Cor spirally corrugated heavy gage pipe of pure ingot iron. The entire installation is a pre-sealed job which is said to insure water tightness. Conduit is heavy asphalt coated. Pipe units are furnished for either single or multiple pipe lines, in standard 20-ft. lengths or any other lengths desired. Standard insulation is 85% asbestos.
MADE BY — *Ric-wiL Co., Cleveland, Ohio.* *4*

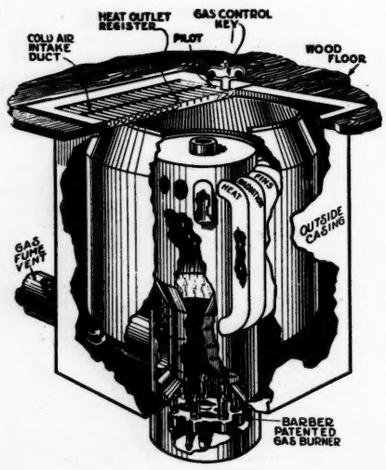


Harvey-Whipple Steel Boiler

NAME—Heet-Generator all-steel boiler.
PURPOSE—For supplying steam utilizing oil as a fuel.
FEATURES—Boiler is of welded steel construction throughout, with a series of crowned sections one above the other, each section containing a thin layer of water. It is said that flue gases must completely fill the space between each set of crown sections before passing up into the next section, resulting in an extremely long flue travel, low stack temperature, and high efficiency. Boiler is housed in a streamlined cabinet. Enclosed within the cabinet is a Master Kraft tankless domestic water heater.
MADE BY—*Harvey-Whipple, Inc., Springfield, Mass.* 5

Sanders Gas Heating System

NAME—Sanders unit heating system.
PURPOSE—For room heating using gas as a fuel.
FEATURES—Unit is designed to be installed in the floor and supplies heated air through a floor register. A gas flue vent runs beneath the floor from the unit to the chimney. Furnace is supplied with an insulated casing.
SIZES—Four sizes with B.t.u. input ranging from 20,000 to 65,000 B.t.u. per hr.
MADE BY—*W. E. Sanders Furnaces, Inc., Memphis, Tenn.* 6



Herske & Timmis Convector

NAME—HT convector.
PURPOSE—A concealed convector for heating room air.
FEATURES—Convector consists of a 1¼-in. circular steel waterway, heavy gage steel fins, all fused together with a cast aluminum alloy core. The manufacturer states that there are no headers, gaskets, or tie rods used in this convector and that the steam passages are large and unrestricted. Convectors are available in all standard sizes and can be furnished to meet special requirements.
MADE BY—*Herske & Timmis, Inc., New York.* 7

Air Conditioning Supply Valve

NAME—Topsy Top-seat valve.
PURPOSE—For controlling the water level in humidifiers, evaporative condensers, and other equipment.
FEATURES—Valve consists of a float, rod, rocker and valve seat. Valve is designed to permit the use of orifices of various sizes so that it is adaptable to a wide range of pressures and capacities. Interchangeable gaskets make it possible to adapt the valve to control various fluids at various temperatures and pressures. The orifice can be cleaned by withdrawing a cotter pin which removes the rocker, rod and float assembly.
MADE BY—*The Air Conditioning Supply Co., Cleveland, Ohio.* 8

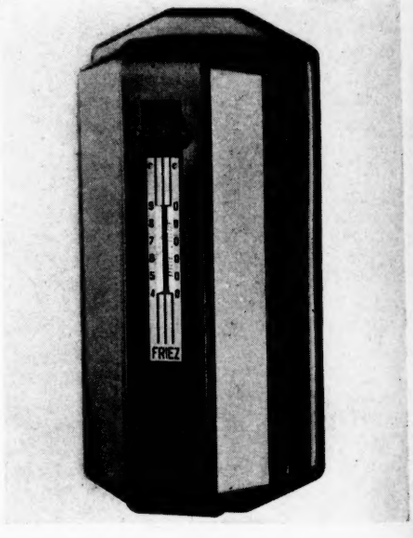
Bacharach CO_2 Indicator

NAME—Fyrite.
PURPOSE—A small portable instrument for showing the amount of carbon dioxide in flue gases.
FEATURES—Instrument is made from a clear plastic material and is said to be fool-proof in operation. The manufacturer states that there are no valves, clamps or leveling bottle and that a complete analysis takes less than 20 seconds.
OPERATION—A dozen strokes of the aspirator bulb fills the Fyrite gas chamber with the flue gas to be analyzed. The sampling hose is then detached which automatically seals the Fyrite and makes it ready for the analysis. To mix the gas with the absorption fluid, the instrument is turned upside down and then back again to its normal position. This takes about 10 seconds. The suction created due to the complete absorption of the CO_2, pulls the absorbing fluid up in the graduated

tube an amount equal to the CO_2 absorbed. The level shows the percentage of CO_2 in the gas. Fyrite is furnished complete with an aspirator bulb, filter, rubber tubing and sampling tubing, all packed in a carrying case which also has room for a Draftrite gage and pencil-type stack thermometer. Kit weighs about 4 lb. and measures 8½ x 7 x 3¾ in.
MADE BY—*Bacharach Industrial Instrument Co., Pittsburgh, Pa.* 9

Friez Room Thermostats

NAME—Friez room thermostats.
PURPOSE—For controlling room temperature.
FEATURES—This new line of Deluxe room thermostats is said to be attractive in appearance and extremely sensitive and reliable. Thermostats are offered in a variety of single- and dual-blade types with or without anticipation, for heating, cooling, day-night or two-stage temperature control applications, with special models for use with relays, valves, damper motors, stoker, gas and oil burner controls.
LITERATURE AVAILABLE—Bulletin TT.
MADE BY—*Julien P. Friez & Sons, Baltimore, Md.* 10



FACTS

YOU OUGHT TO KNOW ABOUT EXPANSION JOINTS

. . . and to keep well in mind when buying

FACT No. 1—The BADGER Corrugated Type of Expansion Joint requires no packing of any kind, hence no maintenance.

FACT No. 2—Standard BADGER Expansion Joints are made in deoxidized copper and stainless steel to take care of pressures up to 300 lbs. and temperatures up to 900° F.

FACT No. 3—Standard BADGER Expansion Joints are made in multiples of corrugations to care for fractions of an inch up to 6" with a single unit and 12" with a double unit.

FACT No. 4—BADGER Self-Equalizing Joints are made to the Directed Flexing design which means that flexing movements are progressively controlled and flexing stresses kept distributed. Neither of these requirements is fully met in the old-style, straight-sided corrugations.

FACT No. 5—**And this is doubly important**—all BADGER Expansion Joints are scientifically heat-treated during fabrication to derive the greatest benefits from this modern metallurgical step.

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JOINTS

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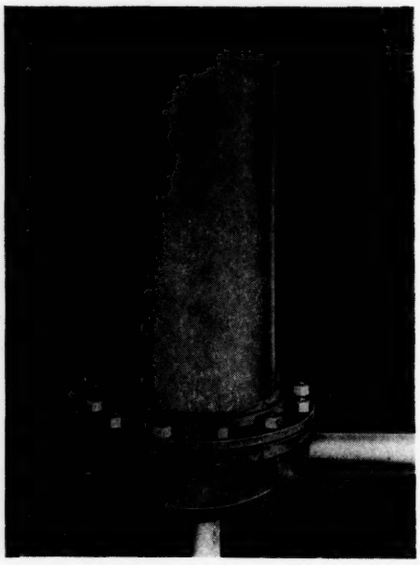
Agents in Principal Cities

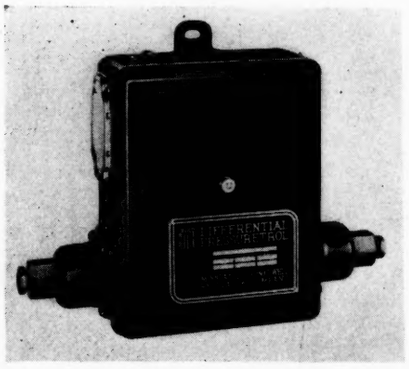
Connor Odor Adsorber

NAME—Dorex pipe line adsorber.
PURPOSE—For removing all types of odors such as oil vapors, fermentation and other objectionable gases from compressed air lines.
FEATURES—Unit is an auxiliary air stream filter of activated coconut shell carbon. It is said that this type of carbon will adsorb odors up to 15 to 20% of its own weight.
MADE BY—*W. B. Connor Engineering Corp., Dorex Air Conditioning Div., New York.* *11*

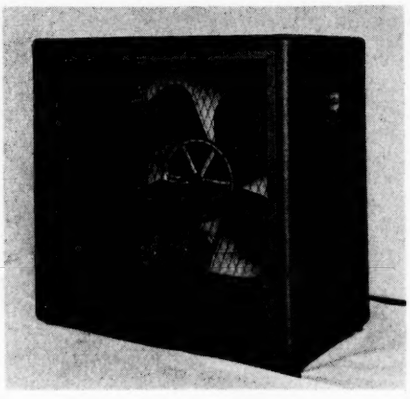


M-H Differential Controller

NAME—Differential Pressuretrol and Differential Thermostat.
PURPOSE—To react to pressure or temperature variations.
FEATURES—The differential Pressuretrol can be installed with an orifice to control the flow of steam or liquids, or it may be used as an alarm device on cooling water systems such as the supply line to water cooled bearings on large generators. It also may be used as an alarm on large refrigeration condensers. The differential thermostats are somewhat similar to the Pressuretrols except that they are



made with temperature elements instead of the pressure bellows assemblies. They can be used for water conservation on air conditioning jobs using well water, or on attic fans where one element is placed in the outside air and one in the house to turn on the fan whenever the differential between the two temperatures reaches a predetermined point. Both controls are available in modulating as well as make and break models.
MADE BY — *Minneapolis-Honeywell Regulator Co., Minneapolis, Minn...12*



Peerless Attic Ventilator

NAME—Peerless attic ventilator.
PURPOSE—For cooling small buildings using large quantities of air.
FEATURES—Fan is portable, light in weight and equipped with grilles for safety protection. It is housed in a cabinet which is treated with sound absorbing material, has an automatic belt tension device and the motor is equipped with overload protection.
SIZES AND CAPACITIES — Three sizes, 30 to 42 in., with capacities ranging from 5500 to 11,000 c.f.m.
MADE BY—*The Peerless Electric Co., Warren, Ohio.* *13*

Air Rectifying Equipment Co. Duct

NAME—Duck duct.
PURPOSE—For carrying air from fans such as in attic fan installations.
FEATURES—Duct is made of 10-oz. duck reinforced at 8-in. intervals with metal hoops and is said to be vermin proof as well as fire resistant. The manufacturer states that the duct can be made to the proper length and taken to the job collapsed and is practical for use in inaccessible places. It is said to be inexpensive and noiseless as the material absorbs sound instead of carrying it. Duck duct boots can also be supplied to house attic fans and motors and are made in square (at fan end) to round (at duct end) to fit any combination of fan frame and duct. A zipper inspection flap is put in one side of the boot.
SIZES—Made in standard sizes 12-, 18-, 24-, 30-, 36-, 42-, 48-, 54- and 60-in. diameters and 3-, 6-, 8-, 10-, 12-ft. lengths.
MADE BY—*Air Rectifying Equipment Co., Tulsa, Okla.* *14*

Bell & Gossett Tankless Heater

NAME—Super tankless heater.
PURPOSE — For supplying domestic hot water.
FEATURES — Heater is designed to furnish large volumes of hot water without the use of a storage tank. The heater can be installed below the water line and the boiler water circulated with a pump or installed above the water line and the boiler water circulated by gravity. Removable front plates are provided on the head of each copper coil element so that the coil can be cleaned. The coils are said to be easily removed by simply unscrewing the nuts from the studs which hold the head in the casing. Copper and bronze are used in all parts in contact with surface water.
SIZES AND CAPACITIES — Made in 19 sizes with capacities ranging from 164 to 940 g.p.h., 100F temperature rise using 180F boiler water; with 212F boiler water capacities range from 329 to 1880 g.p.h.
MADE BY — *Bell & Gossett Co., Chicago, Ill.* *15*

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below circle the item number of the equipment in which you are interested, using the number found at the end of each item.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

(This service available only to engineers or executives)

Fill in your name and address, detach and mail to

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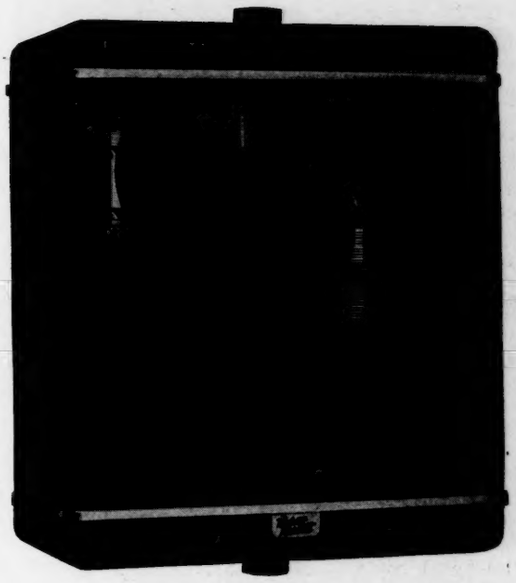

THE ECONOMY of Webster-Nesbitt Unit Heaters is "sweet music" to anyone interested in heating *thrift* as well as *comfort*. Soundness of design, coupled with the Webster-Nesbitt principle of adding heat in moderate amounts to substantial air volume, by a rapid turnover of the air heated, minimizes stratification and wasteful overheating of ceiling areas, cuts down on current and fuel. The units' sturdy construction and their engineered application with the co-operation of the extensive Webster field organization add economies. *Pinch pennies and save dollars* with quiet, efficient Webster-Nesbitt Unit Heaters.

SEND FOR CATALOG

Webster-Nesbitt Giant Heaters of the blower-fan type are recommended for heating extra large interiors. New catalog on request.

Webster Nesbitt UNIT HEATERS

Manufactured by JOHN J. NESBITT, INC., Holmesburg, Phila., Pa.
Distributed Exclusively in the U. S. A. by WARREN WEBSTER & COMPANY, Camden, N. J.
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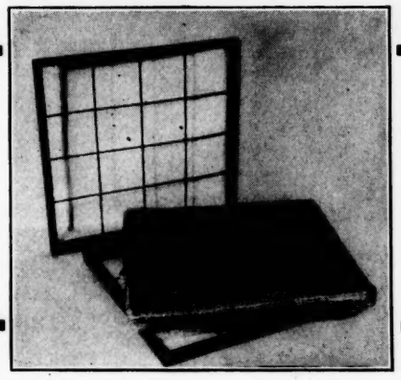
RESEARCH PRODUCTS CORPORATION
Re-Fil-Able Walton Air Filters



The steel frame of the New Walton Air Filter is a permanent part of your air-conditioning equipment. It eliminates fibre frames on filter pads, making replacement costs lower and simplifying disposal, assuring you a greater volume of repeat refill business.

Let us show how installation costs can be lowered by making "Walton Air Filters" part of your equipment.

Write us for information concerning this new highly efficient filter.

RESEARCH PRODUCTS CORP.
MADISON WISCONSIN

We are the three Williams' sons—Will, Willie and Bill. We will save you time and help you make more money on your gravity and air-conditioning installations through the use of

FAVOR-LOX Prefabricated Duct and Fittings. Beautiful installations. No bolts or screws needed. No loose "S" Hooks or Drive Straps. Minimum of cutting. Dealers report installation time cut 50%.

FAVORITE PIPE and Fittings for Gravity. Complete line, die-cut. No hammering. Perfect fit, good looking installations in less time.

FREE: *Complete, easily understood short method for figuring air conditioning jobs. You can complete your figures and price job in one hour flat. Write—Dept. 5 for prices and catalogs.*

THE WILLIAMSON HEATER COMPANY
CINCINNATI, OHIO

TRIPL-IFE Complete Line Quick Service FLO-WARM

Degree-Day Figures for April, 1939

HEATING & VENTILATING continues its eleventh year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for April, 1939.....	686	186	367	164	640	777	809
Degree-days, Sept. 1, '38 to Apr. 30, '39	6769	2552	3944	2235	5626	6351	7624
Degree-days, Sept. 1, '37 to Apr. 30, '38	5972	2820	4070	2435	5604	6336	7264
Degree-days, Sept. 1 to Apr. 30, Normal	6397	2890	4511	2352	5800	6475	7238

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for April, 1939.....	672	604	440	592	507	466	486
Degree-days, Sept. 1, '38 to Apr. 30, '39	6841	5616	4438	5286	4843	5455	5780
Degree-days, Sept. 1, '37 to Apr. 30, '38	6486	5738	4693	5522	5030	4999	5920
Degree-days, Sept. 1 to Apr. 30, Normal	6894	6042	4684	5935	5311	5607	6266

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for April, 1939.....	625	331	896	82	647	345	600
Degree-days, Sept. 1, '38 to Apr. 30, '39	6035	4527	8779	2499	5656	3857	5579
Degree-days, Sept. 1, '37 to Apr. 30, '38	6138	4554	8573	2130	5858	3990	5813
Degree-days, Sept. 1 to Apr. 30, Normal	6264	4988	8721	2428	6016	4244	5795

	Fort Worth, Tex.	Grand Rapids, Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for April, 1939.....	98	641	720	499	586	469	652
Degree-days, Sept. 1, '38 to Apr. 30, '39	2168	5940	7104	5001	5689	4752	6261
Degree-days, Sept. 1, '37 to Apr. 30, '38	2124	6144	7254	5036	5604	5151	6157
Degree-days, Sept. 1 to Apr. 30, Normal	2148	6361	7503	5285	5834	5239	6477

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for April, 1939.....	359	261	615	665	421	190	104
Degree-days, Sept. 1, '38 to Apr. 30, '39	4446	3238	6769	6407	5256	2766	1184
Degree-days, Sept. 1, '37 to Apr. 30, '38	4615	3317	6810	6514	5460	2775	966
Degree-days, Sept. 1 to Apr. 30, Normal	4840	3670	7139	6819	5900	2811	1414

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for April, 1939.....	363	677	204	648	680	260	575
Degree-days, Sept. 1, '38 to Apr. 30, '39	3938	6666	2733	6187	7588	3169	5354
Degree-days, Sept. 1, '37 to Apr. 30, '38	4163	6802	2817	6332	7403	3318	5328
Degree-days, Sept. 1 to Apr. 30, Normal	4180	7193	2950	6856	7614	3507	5672

	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for April, 1939.....	40	513	232	208	432	527	446
Degree-days, Sept. 1, '38 to Apr. 30, '39	1008	4770	2774	3248	5557	5385	4421
Degree-days, Sept. 1, '37 to Apr. 30, '38	1204	4777	3132	3400	5771	5513	4515
Degree-days, Sept. 1 to Apr. 30, Normal	1024	5192	3350	3613	6047	5988	4787

	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for April, 1939.....	486	729	279	589	491	302	283
Degree-days, Sept. 1, '38 to Apr. 30, '39	4741	6556	3625	5469	4830	4889	3415
Degree-days, Sept. 1, '37 to Apr. 30, '38	4921	6518	3604	5508	4797	4959	3632
Degree-days, Sept. 1 to Apr. 30, Normal	5157	6644	4134	5764	5293	5436	3727

	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for April, 1939.....	687	378	324	284	582	342	409
Degree-days, Sept. 1, '38 to Apr. 30, '39	6222	4089	5208	2303	5736	3845	5499
Degree-days, Sept. 1, '37 to Apr. 30, '38	6131	4289	4442	2185	5691	3695	5331
Degree-days, Sept. 1 to Apr. 30, Normal	6472	4585	5319	2417	5958	4396	5989

	Springfield, Ill.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for April, 1939.....	445	658	607	485	698	366	320
Degree-days, Sept. 1, '38 to Apr. 30, '39	4797	6212	5698	4848	6831	3988	4183
Degree-days, Sept. 1, '37 to Apr. 30, '38	4954	5994	5799	4887	6660	4139	4278
Degree-days, Sept. 1 to Apr. 30, Normal	5317	6614	5897	4852	6543	4601	4673

Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the new enlarged edition of the DEGREE-DAY HANDBOOK, published by HEATING & VENTILATING, 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

Another Reason You'll Make More Money with the Complete CURTIS Line

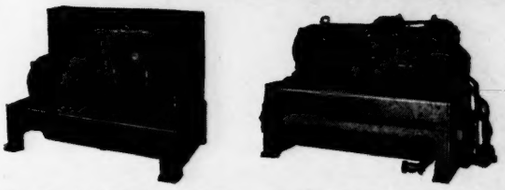
The Curtis
STORE and OFFICE COOLER

● Long known as one of the most profitable lines in the industry, the addition of the Curtis Refrigerated Store and Office Cooler now makes it even more attractive to you. It opens up a great new market — makes possible more sales and profits.

All classes of retail establishments—stores, offices, banks, etc., are demanding air conditioning now. You can fulfill this demand with Curtis' complete, factory designed, packaged air conditioning unit. It mechanically cools, dehumidifies, circulates and filters the air — adaptable for heating — easily and quickly installed — 3 and 5 ton sizes.

The Curtis line of condensing units includes sizes from 1/6 to 30 H.P., air and water cooled. There's a Curtis model for every refrigeration and air conditioning requirement—also unit coolers, coils, evaporative condensers, etc., precision engineered to deliver economical, efficient, care-free performance.

If you're interested in profits, in increasing your sales, write to Curtis for complete information today.



45 Air Cooled Units–42 Water Cooled Units–1/6 to 30 H.P.

Curtis Refrigerating Machine Company
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1999 Kienlen Avenue, St. Louis, Mo.

"Builders of Condensing Units Since 1922"

CURTIS REFRIGERATION AIR CONDITIONING and COMMERCIAL

LACLEDE

FURNACE CEMENT

Ideal for Summertime Installations

The ideal time to make furnace repairs and new installations is during the spring and summer months.

The ideal asbestos furnace cement to use is **Laclede FURNACE CEMENT** —preferred by those "in the know" because it won't disintegrate during long periods of non-use. Once properly applied it's there to stay. You get a tighter joint and it *stays* tight.

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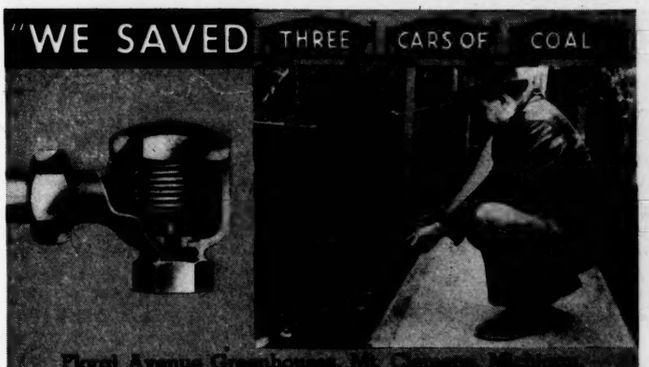
FREE SAMPLE . . . AND FOR AND LITERATURE ON FIREZIST
OUR NEW HAND MOLDABLE PLASTIC REFRACTORY for DOMESTIC FURNACE, STOKER & OIL BURNER LININGS.

LACLEDE-CHRISTY CLAY PRODUCTS CO.
411 N. SEVENTH ST. — ST. LOUIS, MO.
Makers of Fine Heat Resisting Products Since 1844



Floral Avenue Greenhouses, Mt. Clemens, Michigan, installed 400 Sarco Type H and FT Steam Traps three years ago. They intentionally purchased $800 less coal and had three cars left over at the end of the year. "Better heating, absolutely no maintenance difficulties, and Sarco Traps have saved us more than twice their original cost each year."

IF YOU USE STEAM HEAT

Sarco Radiator Traps will give you the same kind of efficiency. Time after time, building managers and contractors tell us that the cost of a changeover to Sarco was solved the first year.

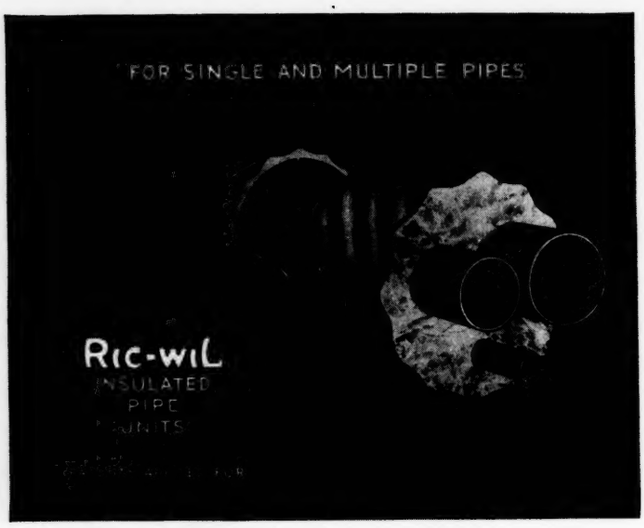
Sarco heating specialties (Inverted Bucket Traps, Inlet Valves, Main Drip Traps, Air Eliminators, Thermostatic Regulators and Temperature Control, etc.) used in the new Sarco plant devoted exclusively to this purpose.

Ask for Catalog No. 42 or Application Data Book.

STEAM HOOK UPS

SARCO

SARCO COMPANY, INC., 183 MADISON AVENUE, NEW YORK, N. Y.
SARCO CANADA LTD., FEDERAL BLDG., TORONTO, ONTARIO



RIC-WIL Insulated PIPE UNITS

Saving in total installed cost, practical features and long-time efficiency are stressed in these PRE-SEALED Units for underground steam lines. These 20-foot Units (or any special lengths desired) come on the job completely assembled, including steam pipe, 85% asbestos insulation or Ric-wiL's Dry-PaC waterproof asbestos, Armco Ingot Iron "Hel-Cor" spirally corrugated and hermetically sealed conduit, and all accessories, ready for installation.

Armco Hel-Cor Conduits are made from heavy gauge pure ingot iron, galvanized, and have a strong lock seam which is positively and permanently water-tight. The spiral corrugations provide ample structural strength which is increased by the reinforcing semi-steel guide rings for supporting the pipe or pipes. A heavy asphalt coating over the galvanized metal resists all forms of deterioration. Armco experience indicates a reasonable life expectancy of 40 years in this type of conduit. Simple cylindrical connectors, made from heavy gauge Armco Asbestos Bonded ingot iron, are easily slipped in place and hermetically sealed after pipe weld has been tested.

Ric-wiL Insulated Pipe Units are furnished for either SINGLE or MULTIPLE pipe lines, the latter being an exclusive Ric-wiL design which is practical, efficient and very economical. Shallow and narrow trenches, minimum ground displacement, mean low cost construction. Labor cost for installing Units is little more than the cost of installing PIPES ONLY with ANY built-up system.

Write at once for detailed Ric-wiL Insulated Pipe Bulletin. Complete catalog 38, describing all types of Ric-wiL Tile and Cast Iron Underground Steam Conduit, also furnished on request.

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New York San Francisco Chicago
Agents in principal cities

REGISTERED IN U. S. PATENT OFFICE

•RIC-WIL•

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

COMING EVENTS

JUNE 13-16, 1939. 33rd Annual Convention, Smoke Prevention Association. Hotel Schroeder, Milwaukee, Wis. An Exhibit of Fuel-Burning Equipment will be a feature. SPA headquarters, City Hall Sq. Bldg., Chicago.

JUNE 27-30, 1939. 30th Annual Convention and Equipment Exhibit, National District Heating Association, Hotel Pennsylvania, New York. NDHA headquarters, 1317 Spruce St., Philadelphia, Pa.

JULY 4-6, 1939. 45th Semi-Annual Meeting, American Society of Heating and Ventilating Engineers, Grand Hotel, Mackinac Island, Mich. ASHVE headquarters, 51 Madison Ave., New York.

SEPTEMBER 20-22, 1939. Annual Conference, National Industrial Advertisers Association, Hotel New Yorker, New York. Headquarters NIAA, 100 E. Ohio St., Chicago.

OCTOBER 4-6, 1939. Exposition of Building, Industry and Services, Hotel Statler, Detroit, Mich. Sponsored by the Mortgage Bankers Association of America. George H. Patterson, Secretary-Treasurer, 111 West Washington St., Chicago, Ill.

OCTOBER 17-20, 1939. 68th Annual Meeting, American Public Health Association, William Penn Hotel, Pittsburgh, Pa. APHA headquarters, 50 West 50th St., New York.

JANUARY 15-18, 1940. Sixth annual convention of the Refrigeration Service Engineers Society in conjunction with the Second All-Industry Refrigeration and Air Conditioning Exhibition sponsored by the Refrigeration Equipment Manufacturers Association, to be held in Chicago. National Secretary of the Society, H. T. McDermott. 433 N. Waller Ave., Chicago.

JANUARY 22-26. 1940. 46th Annual Meeting, American Society of Heating and Ventilating Engineers, Cleveland, Ohio. To be held in conjunction with the 6th International Heating and Ventilating Exposition at Lakeside Hall. Exposition under the direction of Charles F. Roth, International Exposition Co., Grand Central Palace, New York.

JANUARY 23-25. 1940. 35th Annual Meeting, American Society of Refrigerating Engineers, Hotel Cleveland, Cleveland, Ohio.

WITH THE MANUFACTURERS

Herske & Timmis, Inc., 33 W. 60th St., New York, is a new firm formed by *Arthur R. Herske*, former vice president and general manager of sales of the American Radiator Co., and *W. Walter Timmis*, formerly director of the control, system and air conditioning division of the American Radiator Co. Mr. Herske is president and Mr. Timmis vice president of this new company which is introducing a line of controls, systems and equipment for heating and air conditioning. The company announces the appointment of *Miles Gordon* as manager of the concealed radiator division, and *Edward Walter* as chief engineer. The company plans to distribute in the major cities east of the Mississippi through manufacturers' agents. The products include cycling and electronic controls, steel and aluminum convector radiator, various types of heating systems, and other products.

A. R. Herske

W. W. Timmis

Detroit Air Filter Co., 1330 West Congress St., Chicago, has purchased the machinery, equipment, and materials from the American Radiator & Standard Sanitary Corp. for manufacturing the Arco Air Filter and will produce this device under the name Detroit air filter beginning May 1. The plant of the Detroit Air Filter Co. will be under the supervision of *Charles G. Lamb,* former manager of the Arco air filter plant. The entire personnel of the former plant will be retained. Detroit Air Filters will be marketed through the Detroit Lubricator Co., Detroit.

Kewanee Boiler Corp., Kewanee, Ill., has announced an expansion program involving an expenditure of $90,000 for the installation of equipment to manufacture high pressure welded steel boilers. The program, which will probably not be completed until fall, will include an industrial-type mounted portable x-ray equipment for discovering defects in welded joints.

A large annealing furnace will be installed, as well as welding equipment to take care of the heavier plate used in high pressure boilers.

Keystone Brass & Rubber Co., Philadelphia, has appointed *Samuel H. Allston* to its sales staff in charge of sales promotion and advertising, effective June 1. Mr. Allston has been associated with Hart & Crouse Corp., Utica, N. Y., in a similar capacity for the past five years. Prior to that he was advertising manager of the International Heater Co., Utica, for nine years.

Nash Engineering Co., South Norwalk, Conn., has appointed *Edward A. Mead* as sales manager effective May 1. Mr. Mead has been with the Nash Engineering Co. for 14 years, ten years of which he was assistant sales manager.

SUMMER DEGREE-HOURS (ABOVE 85F)* MARCH AND APRIL, 1939

City	March, 1939	April, 1939	April, 1938
Baltimore	0	10	6
Bismarck	0	2	0
Boston	0	0	19
Buffalo	0	0	0
Chicago	0	0	0
Cincinnati	0	0	0
Cleveland	0	0	0
Columbus	0	0	0
Des Moines	0	1	0
Detroit	0	0	0
Grand Rapids	0	0	0
Houston	10	17	0
Indianapolis	0	0	0
Kansas City	0	0	1
Memphis	0	0	0
Minneapolis	0	0	0
New Orleans	0	0	0
New York	0	0	0
Philadelphia	0	0	1
Pittsburgh	0	0	1
Richmond, Va.	0	3	1
St. Louis	0	0	9
San Diego	0	15	0
San Francisco	0	0	0
Savannah	2	12	48
Toledo	0	0	0
Washington	0	25	12

*Based on data made available through the cooperation of the U. S. Weather Bureau.

CERTAINLY, WE'VE GOT TO LINE THESE DUCTS...

"FOR QUIET...

We don't want any complaints about noise after this system is installed. We can line the ducts now with Airacoustic Sheets, without adding much to the cost of the job. They soak up more than 70% of all sounds in the duct. What's more, the system needs Airacoustic Sheets . . .

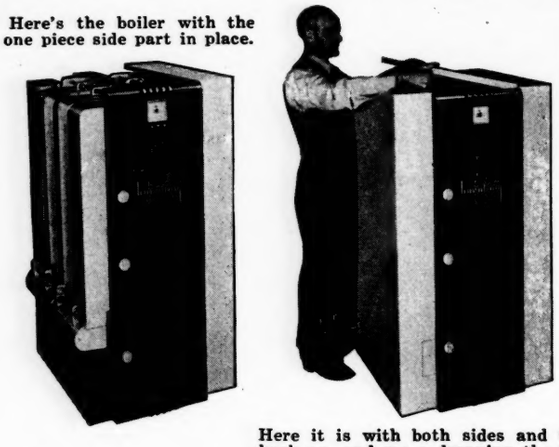
"FOR FIRE-SAFETY...

The National Board of Fire Underwriters has reported too many cases where combustible duct linings have caused serious fire losses. Airacoustic Sheets minimize this risk because they are basically mineral and will not contribute to the spread of fire."

You can use J-M Airacoustic Sheets for lining any type of duct. They are easy and economical to apply. And, once installed, the job is really finished. Humidity offers no costly maintenance problem, for Airacoustic Sheets are exceptionally moisture-resistant. They combine high transverse strength with low heat conductivity. You should have full details. Write Johns-Manville, 22 East 40th Street, New York, N.Y.

Johns-Manville AIRACOUSTIC SHEETS FOR DUCT LININGS

Here's the boiler with the one piece side part in place.



Here it is with both sides and the back on, and me a dropping the top inter place.

Hank Sez: As How It Fits Tight But Goes on Loose

When I sez that tight and loose remark, wuz talkin' about the yeller jacket what goes on our Yello-Jacket Boiler, what stings the fuel bill.

The tight part, has ter do with the way it fits, like a Paris tailor would make the wall paper fittin' kind of dress fur the wimmen.

The loose part, has ter do with the way it goes inter place when you're setting it up. It's like slipping into a satin lined overcoat, what you don't hafter have anyone hold fur you, and maybe give 'em 10 cents.

You can put on one of these yaller jackets and never say a word what wouldn't fit into a Sunday School class. And that's sure a goin' sum. The general opinion is, that no jacket can be made ter go together without a lot o' 8 cylinder cussing.

Now I ain't no Evangelist or preacher feller. But have a notion you can cum pretty near a tellin' how good this Yello-Jacket boiler is, by standin' around when it's being put up, and seeing how polite the setters up stay, right up to the end of the job.

As fur the innards of the Yello-Jacket, it sure can pack a powerful sting fur the fuel bill.

Which makes it unanimous.

And don't forget the Yello-Jacket boiler is Anthracite Industries Approved.

Hank Hindler

Burnham Boiler Corporation

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NEW TRADE LITERATURE

Air Conditioning. A standard-size, 28-page bulletin, No. S-400, describing various applications of the Trane air conditioning equipment. Some sixteen air conditioned buildings of various types are described. Booklet also gives brief descriptions of various items of Trane conditioning equipment. THE TRANE CO., LA CROSSE, Wis. 16

Air Filters. A standard-size, four-page, loose-leaf catalog, illustrating and describing the Davies Type M air filter which is especially designed for use in air conditioning and ventilating systems where high efficiencies are required and space allotted to air filters is small. Gives information on the method of loading, various filter mediums, installation, performance and specifications. DAVIES AIR FILTER CORP., NEW YORK.....17

Controls. A four-page, loose-leaf bulletin, S-217, on General gas controls. Gives information on the Thermopilot, manual reset valve, magnetic gas valves, diaphragm valves, water valves, space heater control, Metrotherm and relays. GENERAL CONTROLS, CHICAGO, ILL. 18

Controls. A standard-size, 48-page catalog, No 300, on Mercoid automatic controls. Gives illustrations, information and prices on the complete line of Mercoid automatic controls and valves. Also gives information on Federal pressure and altitude gages. THE MERCOID CORP., CHICAGO, ILL. 19

District Heating. A standard-size, four-page bulletin, A-3907, on Ric-wiL insulated pipe units. These pipe units are prefabricated and assembled at the factory, and include steam pipe, guide ring pipe supports, insulation, conduit and all accessories ready for installation. Gives information on construction, typical specifications, method of installation and sizes available. THE RIC-WIL CO., CLEVELAND, OHIO. 20

Evaporative Condensers. A standard-size, four-page bulletin, illustrating and describing Frick evaporative condensers for ammonia and Freon-12 refrigerating systems. Gives information on the construction, dimensions and capacities. FRICK CO., WAYNESBORO, PA. 21

Fans. Catalog describing and illustrating the Wing-Scruplex corrosion-resisting fans. Fans are intended for use under conditions that quickly put ordinary fans out of service. Construction features, capacities, horsepower and similar information are given. L. J. WING MFG. CO., NEW YORK. 22

Flexible Metal Tubing. A standard-size, 24-page catalog, illustrating and describing seamless flexible metal tubing made by the American Metal Hose Branch of the American Brass Co. Over 75 pictures and charts are used to illustrate various applications of this tubing. There are also complete engineering data and specifications with simple installation rules. THE AMERICAN BRASS CO., AMERICAN METAL HOSE BRANCH, WATERBURY, CONN. 23

Hot Water. A standard-size, four-page bulletin on the Rochester turbine circulator pumps and universal check valves which are designed for use with forced hot water heating systems. Gives information on the construction, sizes and capacities of these devices and also shows a number of typical installations. ROCHESTER CIRCULATOR CORP., ROCHESTER, N. Y.....24

Hot Water Heating. A standard-size, 32-page, loose-leaf bulletin, No. 339, describing the complete line of Bell & Gossett hot water heating equipment. Booklet is divided into three sections, each with a separate identifying color. First section takes up warm water heating systems; second, domestic water heating systems; and third, electrical controls. Gives information on the construction features and capacities of the various Bell & Gossett fittings as well as information on sizing and installing this equipment. BELL & GOSSETT CO., CHICAGO, ILL. 25

Oil Burners. A standard-size, four-page, two-color pamphlet describing the Todd variable capacity pressure atomizing burner. Gives information on construction and operating features. TODD COMBUSTION EQUIPMENT, INC., NEW YORK. 26

Pipe. A standard-size, 20-page catalog entitled Revere Copper and Brass Pipe and Tubing. Catalog describes the types of the Revere Copper & Brass tube and piping which are available and discusses their uses for heating, air conditioning, plumbing and underground service. Also gives information on dimensions, weights and properties, as well as installation data and suggested specifications. REVERE COPPER & BRASS, INC., NEW YORK. 27

Refrigeration Equipment. A standard-size, 12-page catalog, No. 5, devoted to refrigeration products, including water regulators, gage sets, ammonia shut-off and line valves, dehydrators and strainers. Catalog includes drawings, photographs, descriptions and specifications of these products. CYRUS SHANK COMPANY, CHICAGO, ILL. 28

Safety Appliances. A 48-page book, "Industrial Head and Eye Protection," listing goggles, respirators, spectacles, masks, welding helmets, and other safety devices. CHICAGO EYE SHIELD CO., CHICAGO, ILL. 29

Unit Heaters. A standard-size bulletin, H-6AB, on Wing featherweight unit heaters which are said to be suitable for heating any size of plant regardless of ceiling height. Engineering data, heater capacities, construction details and other information are given. L. J. WING MFG. CO., NEW YORK. 30

Valves. A large size broadside entitled "Service Characteristics of Globe Valves and Gate Valves—How to Pick the Right One Every Time." Describes the proper method of selecting the right gate or globe valve for your service need and tells how to use the Crane valve selection guide charts which are included. CRANE CO., CHICAGO, ILL. 31

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HEATING & VENTILATING
148 Lafayette St., New York, N. Y.

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24	25	26	27	28	29	30	31

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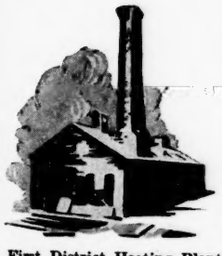
ENGINEERED for YEARS of DEPENDABLE DISTRICT STEAM HEATING SERVICE



First District Heating Plant
Lockport, N. Y., 1877

Greetings from ADSCO to National District Heating Association, 30th Annual Convention in New York City at Hotel Pennsylvania, June 27-30th, 1939.

24" 300 lbs. ADSCO Double Type Piston-Ring Expansion Joint with 8" traverse per slip, beveled ends for welding, purchased by large Eastern public utility company.

ADSCO Catalog No. 35 Describes All Products

From the latest ADSCO Catalog No. 35 you can specify or order all products for the complete installation of underground or surface steam lines, except pipe. A copy of this catalog should be on the desk of every consulting engineer, heating contractor, Supt. of Buildings in colleges and institutions and chief engineers in industrial plants, public utility companies, railroads, etc. Over 136 pages of descriptive data, dimensions and prices for specification writing, estimating or ordering. Write for your copy today to Dept. V.

ADSCO PRODUCTS

- Slip Type and Packless Type Expansion Joints
- Wood Casing and Tile Conduit for underground pipe lines
- Pipe Supports
- Alignment Guides
- Saddle Plates
- Pipe Anchors
- Condensation Meters
- Steam Flow Meters
- Water Heaters
- Steam Traps
- Reducing Valves
- Insulation Supports

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS